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State Natural Area Strategy

Wisconsin Department of Natural Resources

First Edition • 2020

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Acknowledgements

This Strategy could not have been completed without the assistance of numerous individuals, agency staff and other groups. This was truly a team effort and the State Natural Area Core Planning Team would like to express our thanks to the following:

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Front Cover Photo: Dan Eggert

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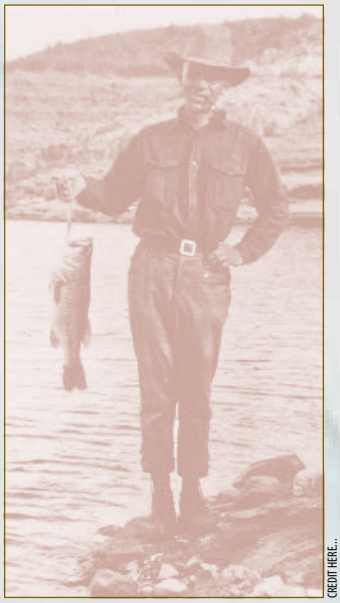

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Guiding Vision from the System Founder

"if the land mechanism as a whole is good, then every part is good,
whether we understand it or not.

If the boita, in the course of aeons, has built something we like but not understand,
then who but a fool would discard seemingly useless parts?

To keep every cog and wheel is the first precaution of intelligent tinkering."

Bureau of Natural Heritage Conservation
Wisconsin Department of Natural Resources
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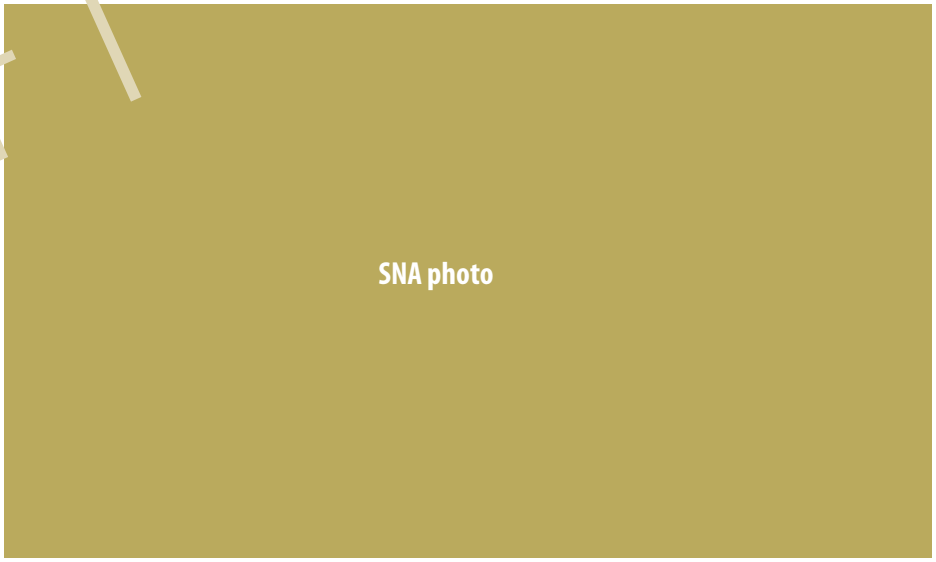

Executive Summary

Background and Context

Wisconsin features an exceptional wealth and diversity of plants, animals and natural communities among states sharing the same latitude, a reflection of the state's diverse geology and its location at the crossroads of three major biomes — the northern conifer-hardwood forest, eastern hardwood forest, and prairie. A century after statehood, Aldo Leopold and other Wisconsin conservation giants worried this mosaic of **natural communities** was disappearing and began working to preserve this natural heritage. Their efforts spurred the Wisconsin Legislature to establish the first statewide nature preserve system in the nation in 1951, with a mission to locate, establish and conserve a system of natural areas representing the wealth and variety of Wisconsin's natural communities for education, research and long-term protection of the state's biological diversity.

The State Natural Area (SNA) system has grown to include nearly 700 sites owned and managed by The Wisconsin Department of Natural Resources (DNR) and more than 60 other partners. Collectively, these lands account for only about 1 percent of Wisconsin's 34.7 million acres, yet 90% of Wisconsin's rare plant species and 75% of rare wildlife species can be located there.

These lands also safeguard remnant prairies, oak and pine barrens, oak savannas, Great Lakes shoreline, Eastern Hemlock relics and other natural communities considered among the rarest in Wisconsin and the world.

Stressors on SNAs have increased significantly since the system's original long-range plan was adopted in 1983 and has spurred SNA Program staff to develop this plan to guide the next decade.

Climate change, invasive species, habitat fragmentation and more challenge the ability of DNR and partners to achieve the program's mission — protecting and managing representative examples of high-quality natural communities in the ecological landscapes where they historically occurred. Climate change vulnerability assessments estimate, for example, that one-third to more than one-half of Wisconsin's natural communities are highly vulnerable to climate change.

By extension, many SNAs protecting those natural communities are likely to experience significant changes in composition of associated plant and animal species.

Addressing these and other stressors requires strategies incorporating the latest scientific information and collaborating with partners and stakeholders. Through identifying new strategies, this document provides a framework for establishing protection and management priorities for SNAs for the next decade.

Natural Community

An assemblage of different plants and animals living together in a particular area at a particular time in a specific habitat. Communities may be named for their dominant plant species, a prominent environmental feature, or both.

Statewide Environmental Challenges

The number, extent, and magnitude of environmental challenges impacting SNAs have increased and are limiting our ability to sustain pre-settlement communities. Primary environmental challenges include:

- **Habitat loss and fragmentation**
  Wisconsin has experienced significant conversion of natural habitats to human uses, resulting in the loss, fragmentation and alteration of natural communities.
- **Altered natural disturbance regimes**
  Fire suppression, wetland drainage and other hydrologic modifications have impacted the structure and composition of natural communities.
- **Non-native invasive species**
  Invasive species—including plants, animals, and diseases— are among the leading threats to natural areas. Their impact is likely to increase due to environmental factors favoring the spread of invasive species.
- **Over-abundant white-tailed deer**
  Herbivory resulting from high densities of White-tailed deer have negatively impacted the composition, structure, and function of natural communities.
- **Nitrogen deposition and phosphorus enrichment**
  Over the past two centuries, atmospheric deposition of reactive nitrogen in Wisconsin has increased 10 to 30 times relative to natural rates of deposition, favoring growth of nitrogen-loving plants, many considered invasive species, at the expense of native plants and natural communities. Both nitrogen and phosphorus enrichment impacts wetland and aquatic communities by increasing algae growth and in turn impacts aquatic life.
- **Climate change**
  The current rate of climate change is 10 times the average historical rate and accelerating, threatening plant and animal species associated with natural communities found within SNAs.

State Natural Area System Assets

Since inception, the SNA Program has focused on protecting and managing the best examples of Wisconsin's native plant communities using pre-settlement communities present during the mid-1800s as an ecological reference point. The SNA Program now oversees 691 designated SNAs encompassing more than 402,000 acres of land and water. Of these, the DNR owns and manages 431 sites totaling 217,059 acres while more than 60 partners own and manage 260 sites.

Nearly all SNAs are open to the public for low-impact recreation like hiking, hunting and nature viewing. Public use has increased markedly in recent years, as have requests to access SNAs for currently prohibited uses. This strategy provides guidance for developing policy to address new public use requests.

A New Approach to Ecological Representation for Protection and Management of SNAs

A significant goal of the SNA Program is protecting and managing representative examples of high-quality natural communities in the ecological landscapes in which they historically occurred. The SNA Program have worked toward this goal over the years by reviewing the current framework of protected areas and trying to fill in gaps in the natural communities protected. Yet growing environmental challenges mean this "Gap Analysis" approach alone is insufficient to protect the full spectrum of Wisconsin's native biodiversity into the future. Additionally, important baseline environmental conditions and drivers are changing over time, necessitating a shift in how historical reference conditions are used as the main target of SNA management. Historical reference conditions are still useful but going forward will be considered as waypoints, or interim targets, rather than restoration endpoints.

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Five Goals Guide the Future of the SNA Program

Five goals will guide the SNA Program over the next 10 years. They are:

1. Protect the native biodiversity associated with Wisconsin's plant communities;
2. Protect sites containing significant geological and archeological features;
3. Prioritize and provide stewardship for all DNR-managed SNAs using principles of conservation biology and ecosystem management;
4. Identify research needs and accommodate scientific investigation;
5. Provide opportunities for environmental education and compatible use.

Achieving these goals requires new approaches to biodiversity protection within SNAs. Guiding principles to establish those new approaches are listed in order of relative importance.

- Resilient and connected lands. Focus on lands that are projected to be resilient to climate change and other stressors, and that are connected to other resilient lands.
- Ecological integrity. Protect sites with higher site quality (i.e. vegetation structure, composition and lack of hydrologic or soil disturbance), larger size, and within landscapes conducive to effective, durable conservation.
- Ecological representation. Maintain and establish representative examples of high-quality communities across a range of sites and ecological landscapes, with a focus on sites that are resilient, connected, and have high ecological integrity.
- Conservation Opportunity Areas. Protect SNAs that lie within Conservation Opportunity Areas identified in the Wisconsin Wildlife Action Plan.
- Landscape-scale projects. Facilitate protection and management efforts across landscapes spanning thousands to tens of thousands of acres.
- Fragmentation and future development. Prioritize sites less threatened by habitat fragmentation, land use change and residential/commercial development pressures.

The SNA program will strive to consistently apply the above guiding principles to direct an adaptive management approach to address environmental challenges and enable strategic planning and implementation of management activities, maximizing use of limited resources and enhancing return on conservation investments.

Critical to the implementation of any adaptive management or habitat conservation program is the need for metrics that allow for evaluation of the success of decisions and management actions in achieving goals of the program. It allows for iterative learning and making adjustments to conservation goals, design, and management actions over the lifespan of this strategy. The SNA Program recognizes that monitoring and research are two important components for measuring success.

This strategy provides a unifying approach for administering and managing all aspects of the State Natural Area system given existing and anticipated environmental challenges. It establishes guidelines for maintaining the persistence and viability of the SNA Program into the future. Although the best scientific knowledge was used to develop this plan, the dynamic nature of a rapidly changing world requires the plan be adaptive. Its completion sets the stage for developing an implementation plan incorporating the objectives and strategies identified and establishes action items for each strategy. Implementing these actions will contribute to the long-term protection of Wisconsin's native biodiversity.

State Natural Area Vision Statement

We envision a system of State Natural Areas that protects the full range of Wisconsin's natural heritage, addresses environmental challenges through stewardship and is valued by all generations.

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Background and Context

1. Introduction and Purpose of the Strategy

This State Natural Area Strategy provides a framework for establishing SNA Program priorities for protection over the next 10 years. The last long-range plan was published in 1983. Since then, environmental challenges have increased, including the spread of invasive species, emergence of new diseases and pests, increased demand for outdoor recreation, ongoing habitat loss and fragmentation, increasing white-tailed deer populations, and accelerating climate change impacts.

Climate change received little consideration when the previous SNA Plan was written but the impacts of climate change are now well-accepted and will make it difficult or even impossible to maintain certain vulnerable natural communities over the long-term. Recognition of these growing environmental challenges spurred development of this new long-range strategy.

The strategy does not provide specific protection or management recommendations for the State Natural Area system. Rather, it provides the framework for developing such recommendations in the forthcoming SNA Implementation Plan. And while elements of this strategy apply to all SNAs, much of the focus is on properties owned and managed by the state. This focus does not, however, diminish the importance of the 260 partner-owned and managed SNAs. In fact, accomplishing the SNA Program mission will require strong, ongoing collaboration with statewide system partners, underpinned by broad public support.

"Accomplishing the SNA Program mission will require strong, ongoing collaboration with statewide system partners, underpinned by broad public support."

2. Wisconsin's SNA Program

While many other DNR programs and partners contribute to protecting Wisconsin's biodiversity, the SNA Program is uniquely charged with, and focused on, the conservation and management of Wisconsin's rare flora, fauna and natural communities.

2.1 Mission and Goals

The mission of the SNA Program is to locate, establish and conserve a system of SNAs that as nearly as possible represents the wealth and variety of Wisconsin's native landscape for education, research and most importantly, to help secure the long-term protection of Wisconsin's biological diversity for future generations.

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Natural Heritage Inventory

A statutorily required system of collection, storage and management of rare species information.

DNR's Natural Heritage Conservation biologists and partners add to the NHI by locating and catalog rare plants and animals and high quality natural areas, following the same standard methodology used in all other states and several other nations across the western hemisphere.

Biological Diversity Photo

or 3 Biomes here

Over the decades, the stated goals and objectives have remained consistent through the SNA Program's history:

- Acquire land and land rights for areas containing high-quality natural communities, habitat for rare, endangered, and threatened species, and significant geological and archeological features.
- Legally protect sufficient examples of each of Wisconsin's natural communities and natural features across ecological landscapes and a range of environmental gradients to ensure preservation of the state's biological diversity.
- Provide ongoing stewardship for natural areas using principles of ecosystem management and conservation biology.
- Maintain reference areas or benchmarks for comparison with managed lands where protection of native biodiversity is not the primary objective.
- Provide opportunities for scientific research on natural systems where natural processes are allowed to proceed essentially unimpeded.
- Provide areas for formal and informal environmental education to students and the public to gain understanding and appreciation of biotic communities and their component species.

2.1.1 Biological Diversity: Definition, Importance and Indicators

Biological diversity, or biodiversity, can be defined as the variety of life and associated ecological processes. This includes genetic, species, natural community and ecosystem diversity. The term biodiversity, as used in this strategy, refers specifically to species native to Wisconsin and/or the Great Lakes region, including species near the state border that may expand into Wisconsin as the climate changes. While non-native or invasive species originating from other continents or U.S. regions are technically part of biodiversity, they are excluded from setting conservation priorities for the SNA Program.

Biodiversity is important for a variety of reasons. It forms the foundation of ecosystem services ranging from nutrient recycling and pollination to oxygen production and provision of food and clean water. Biodiverse natural communities and ecosystems tend to be more resilient to disturbance than less diverse systems because they have a greater variety of species that may become re-established after natural or anthropogenic events. High biodiversity also can help limit the spread and impact of pests and disease, and has been linked to increased physical, mental and spiritual well-being in people.

Biodiversity can be assessed at a variety of scales, including genetic diversity within a species; the number of species within communities; and the number and types of natural communities within a site or region. Diversity also can be expressed in terms of evenness. The degree to which an equal number of species, are equally abundant relative to one another compared to very few species being dominant at a given site.

Many ecological processes, including natural disturbances such as fire, flooding and wind throw, were major drivers in developing Wisconsin's natural communities and are necessary to maintain biodiversity. Such disturbances may seem destructive but often rejuvenate natural communities when they occur with the frequency, intensity, timing and scale similar to the conditions under which communities evolved.

2.1.2 Natural Communities as a Coarse Filter for Biodiversity

Compared to other states in the northern latitudes, Wisconsin has a high level of native biodiversity due in part to its location. Three major biomes — the northern conifer-hardwood forest, eastern hardwood forest, and prairie – converge here. Wisconsin is also geologically diverse, featuring a variety of surficial bedrock and glacial landforms. These create habitats ranging from Great Lakes shoreline dunes, to the Mississippi River floodplain forests, to old-growth northern forests and Driftless Area bluff prairies.

Wisconsin is home to 1,900 native plant species and nearly 650 vertebrate species, including 284 species of breeding birds and 70 mammals. Wisconsin also is home to an estimated 35,000 - 65,000 terrestrial and aquatic invertebrate species (WDNR 2015a).

Mapping the distribution of all species across Wisconsin and designing a preserve network based on such data is not practical, especially for historically understudied groups like invertebrates. For the SNA Program to fulfill its mission of conserving Wisconsin's biological diversity, natural communities are used as a coarse filter or proxy to protect the diversity of habitats in which species occur. While this approach encompasses and facilitates the protection of all native biodiversity, it emphasizes conserving species characteristic of high-quality natural communities rather than simply maximizing the number of species at a given site.

The DNR classifies natural communities based on the vegetation present. Developed by John Curtis in 1959 as the first state-level vegetation classification in the nation, Wisconsin's natural communities are classified according to patterns of plant assemblages and associated climate and physiographic features such as soil, bedrock, and glacial landforms (Curtis 1959). The DNR currently recognizes 99 natural communities, including 73 terrestrial and 26 aquatic types (WDNR 2017). High-quality examples of natural communities are the basis for Wisconsin's SNA system, and are cataloged and tracked in the Wisconsin Natural Heritage Inventory (NHI) database. As of 2019, the SNA system protects at least one mapped example of 96% of classified natural communities.

Based on an analysis of NHI data, 90% of Wisconsin's rare plant species and 75% of rare animal species are represented in the current SNA system using the natural communities coarse filter approach. Including common species, the total percentage of native biodiversity conserved is likely much higher since common species typically have less specific habitat requirements and larger ranges than rare species and occur in more locations. The natural community approach also is useful for categorizing and evaluating SNA type and quality, designing management strategies and assessing the system's vulnerability to large-scale stressors like climate change.

2.1.3 Rare Species Conservation on State Natural Areas

Despite the effectiveness of using natural communities as a coarse filter for conserving native biodiversity, it is also important to consider a fine-filter approach for rare species. There are currently 865 rare species on the NHI working list, most of which are tracked in the NHI database. Some occur at a handful of locations while a few species have been documented at only one location. Other rare species such as grassland birds do not depend as strongly on high-quality natural communities but have structural habitat requirements that may include anthropogenic habitat like pastures or alfalfa fields. Sites supporting some rare species may have low quality vegetation but still merit protection. Thus, from a planning and protection perspective, a coarse fine filter approach is necessary to adequately protect Wisconsin's biodiversity. From a management perspective, actions intended to maintain rare species habitat such as prescribed fire, managing invasive species and woody species control in prairies and savannas, are similar to those used to maintain high quality natural communities.

2.2 SNA Program Origin

The SNA Program was initiated in 1945 by the Wisconsin Conservation Commission with the formation of a Natural Areas Committee within the Wisconsin Conservation Department, the precursor to today's Department of Natural Resources. Notably, the proposal to create the Natural Areas Committee came from legendary conservationist Aldo Leopold, who served as a commissioner on the Wisconsin Conservation Commission at the time. The committee was charged with protecting areas of unique botanical interest by gift or purchase.

In 1951, the legislature formalized the conservation of natural areas by adopting state statute creating the State Board for the Preservation of Scientific Areas. Lawmakers' action pioneered the nation's first statewide natural areas protection program. The State Board for the Preservation of Scientific Areas was charged with advising the Wisconsin Conservation Department and formulating policies to select, acquire, manage and preserve natural areas necessary for scientific research, the teaching of natural history, and the protection of rare species and natural communities.

The board operated without a staff or budget until the first program administrator was hired within the Wisconsin Conservation Department in 1966. State government reorgani-

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96% Coverage

The DNR currently recognizes 99 natural communities, including 73 terrestrial and 26 aquatic types. As of 2019, the SNA system protects at least one mapped example of 96% of these classified natural communities

Rare species photo

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zation in 1967 created the current DNR and renamed the State Board for the Preservation of Scientific Areas to the "Scientific Areas Preservation Council." Wisconsin's 1985 budget bill changed the council's name to the "Natural Areas Preservation Council" and the State Scientific Areas Program became the State Natural Areas Program to conform to this change. The duties of the council and program mission remained essentially unchanged.

2.2.3 Enabling Legislation and Applicable Law

Wisconsin State Statute and Wisconsin Administrative Code, as enacted by the state legislature and approved by the governor, enable and regulate the SNA Program and the Natural Areas Preservation Council. Relevant statutes and rules are as follows:

- Chapter 566, Laws of 1951, as enacted by the Wisconsin Legislature and signed by the Governor, created 23.27 of the State Statutes enabling the formation of the State Board for the Preservation of Scientific Areas. The statute stipulates the composition of the board, its duties and authorities.
- Chapter 23.27 was later renumbered and now provides authority for the DNR to operate the SNA Program and acquire lands with state appropriations. It defines terms related to the program, specifies the importance of natural areas, and establishes the Natural Heritage Inventory Program and lists its duties.
- Chapter 23.28 of the statutes empowers the DNR to designate SNAs on DNR and partner lands, create Research Natural Areas, and enforce protection of SNAs. It also states that the DNR is responsible for stewardship of state-owned SNAs.
- In Chapter 23.29, the statutes provide the extensive framework and process for the legal dedication of natural areas, including eligibility requirements and stipulations that must be included in SNA Articles of Dedication. The procedure for removing a natural area from dedicated status is specified.
- The DNR's underlying authority for land acquisition lies in Chapters 23, 27, 28 and 29 of the statutes. Key sections include Section 23.09, the "Conservation Act," which calls for an adequate and flexible system for the protection, development and use of outdoor resources in Wisconsin, and Section 23.0917, which establishes the Knowles-Nelson Stewardship Program, which funds land acquisition. In addition, the Natural Resources Board has further clarified through Administrative Code NR 1.40 the types of lands that are priorities for acquisition, including "…land to protect rare and threatened natural resources; to protect genetic and biological diversity; and to protect, manage or restore critical fish and wildlife habitat."
- The Natural Area Preservation Council's duties are specified in Chapter 23.26 of the statutes. It directs the council to provide advice and recommendations to the DNR concerning the designation, acquisition, management, protection, use, and withdrawal of SNAs. Chapter 15.347(4) of the statutes creates the council and specifies its membership and appointing entities.
- Administrative Code Chapter NR 1.32 codifies the Natural Resources Board's recognition and support of the legislature's intent to acquire and protect natural areas. The code reiterates the purpose and duties of the SNA Program and the Natural Areas Preservation Council and specifies Natural Resources Board oversight of the program.

2.2.4 The Previous Long-range SNA Plan

Many documents and directives have informed the trajectory of the SNA Program. The first and only comprehensive strategic plan was created by the Scientific Areas Preservation Council and DNR Scientific Areas staff in 1983. The document recounted the history of natural area protection in the state and detailed the approach used to establish the system including the inventory, classification and designation. It also provided information on the public use, research, education and management of sites. Though dated, the long-range plan continues to be useful in managing the SNA system.

Other notable sources of guidance for the SNA Program include Wisconsin's Biodiversity as a Management Issue (WDNR 1995), the Wisconsin Wildlife Action Plan (WDNR 2015a), and the Ecological Landscapes of Wisconsin (WDNR 2015b).

Abe's Woods sign

Photo of Cover of 1983 Plan

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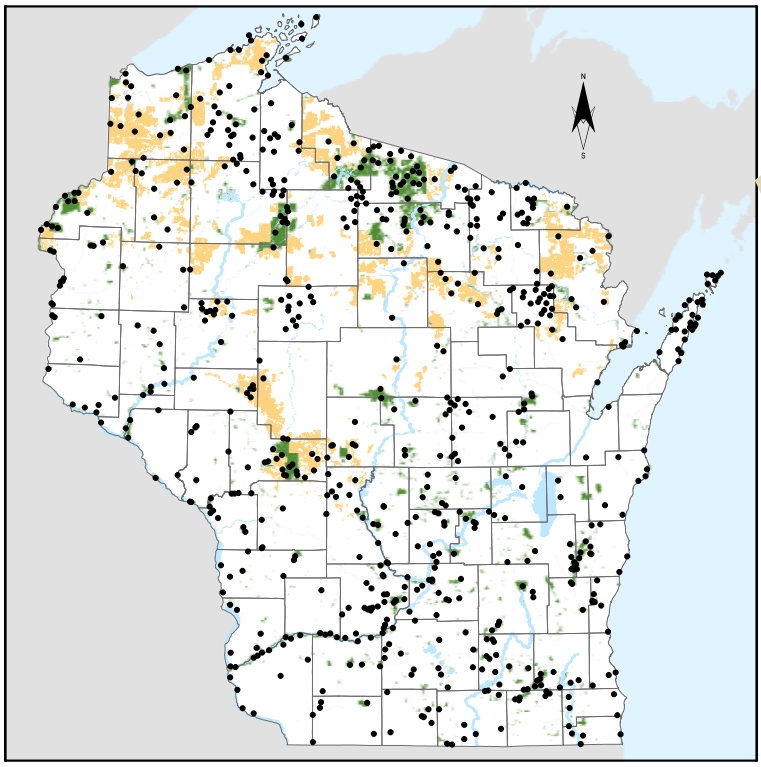

Figure 1. Statewide distribution of the 691 state natural areas.

2.3 System Overview

As of February 2020, the State Natural Areas system has 691 designated SNAs encompassing more than 402,000 acres of land and water. By these measures, Wisconsin's is the largest system of state nature preserves in the nation and its sites are distributed throughout the state. Concentrations of sites are found in ecologically-rich areas including the Door Peninsula, Lower Wisconsin River Valley, Northern Highland and Kettle Moraine State forests, Baraboo Hills, and along the St. Croix and Mississippi river corridors (Figure 1).

Wisconsin's SNAs range from 3 to 9,612 acres with an average size of 585 acres and a median size of 239 acres. SNAs are predominately small, most are less than 500 acres in size. (Figure 2).

DNR manages 431 SNAs comprising 217,059 acres. Of these, 139 are administered and managed by the Bureau of NHC (NHC). The remaining 292 are embedded within other DNR properties, including Wildlife Areas, State Forests, State Parks, or Fishery Areas, and managed cooperatively with those programs. An additional 260 SNAs are on lands held by more than 60 SNA Program partners. Partners include federal agencies, counties, land trusts and other nonprofit conservation organizations, educational institutions, private citizens, and municipalities (Figure 3 and Appendix 7).

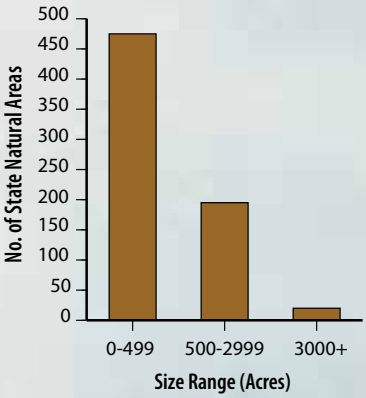

Figure 2. The size range of 691 state natural areas.

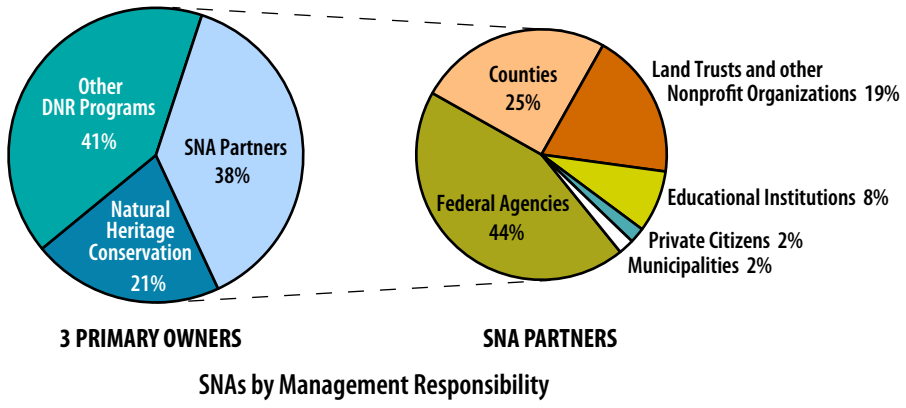

Figure 3. Percent of the 691 SNAs managed by the Bureau of Natural Heritage Conservation, other DNR programs, and partner organizations.

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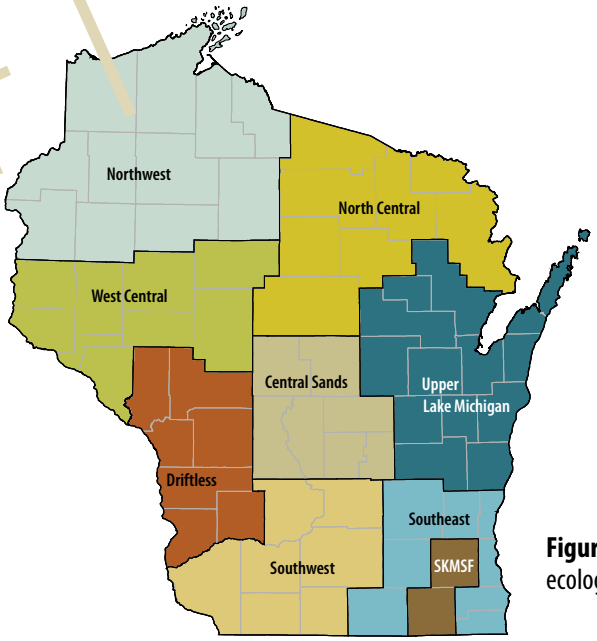

Figure 4. Statewide map showing NHC ecologist working areas.

2.3.1 SNA Program Administration, Operations and Staffing

The SNA Program resides within the Bureau of NHC in DNR's Division of Fish, Wildlife and Parks. The Bureau is comprised of three sections: Species Management, Program Integration and Field Operations. Administration of the SNA Program is shared by the latter two sections. Program Integration Section staff are responsible for SNA policy and rule development, outreach, data provision, research permits, coordination of land acquisition and long-range planning. These staff are also responsible for coordinating the Natural Areas Preservation Council meetings and activities and providing SNA-related support services for DNR-wide initiatives and programs. Section staff ensure consistent statewide program implementation, including collaboration with external partners. Day-to-day SNA Program operations are managed by three full-time and one half-time permanent conservation biologists located in DNR's central office in Madison all supervised by a section chief.

The primary responsibility of SNA Field Operations staff is caring for 139 of 431 SNAs under DNR ownership and management. Staff inspect sites, plan and conduct prescribed burns and other management activities, and develop facilities including parking lots. Field Operations staff also share responsibility with other DNR personnel to ensure the protection and management of 292 more SNAs embedded within wildlife areas, state parks and other DNR properties. From an operations perspective, the SNA Program is the lead management program on most DNR-owned SNAs regardless of their parent program, focusing management on the sites with the greatest needs. In addition, the 260 SNAs owned by external program partners like the U.S. Forest Service and The Nature Conservancy are administered and managed in collaboration with SNA Program staff.

A section chief supervises all field operations staff with support from a team leader. To enable effective management at a statewide scale, nine working areas have been established (see Figure 4), each staffed by one field ecologist and supported by two to seven natural area technicians. There are 34 natural area technicians statewide.

The Field Operations Section Chief also directs the SNA Volunteer Steward Program, staffed by a full-time coordinator who recruits and organizes citizen volunteers to augment resource management activities on SNAs. Since its beginning in 2011 with a single half-time staff-person, the program has grown and now plays an important role in property management, particularly the control of invasive plants. Volunteers annually provide more than 5,000 hours of labor on 43 SNAs covering 3,296 acres. The estimated value of their support is $127,000.

While the SNA Program now has the largest staff complement in their history, threats to the state's biodiversity are growing. The NHC Bureau will continue to seek resources to expand protection and management capacity to ensure effective, long-term protection and management of the State Natural Area system.

Volunteers at work photo

NAPC council in the field photo

2.3.2 Funding and Budget

The SNA Program is financially supported by a variety of state, federal and private funding sources. Central Office SNA staff and associated administrative operations are funded with NHC program monies originating primarily from people donating to the Endangered Resources Fund on their Wisconsin income tax forms, from the sale of specialty license plates (wolf, badger, and eagle), and from Federal Aid in Wildlife Restoration Act monies. Field operations are funded through a combination of federal funds — State Wildlife Grants and Federal Aid in Wildlife Restoration Act— NHC Bureau funds, and a variety of internal, external, and private grants and gifts. Revenue generated from timber sales conducted on SNAs managed by the NHC Bureau also supports the SNA Program. Funding for acquiring SNA land is detailed in Section 3.3 below.

2.3.3 Natural Areas Preservation Council

The SNA Program is advised by the 11-member Natural Areas Preservation Council and endowed with powers stipulated in state statute and administrative code as described previously. DNR appoints two representatives to the council, the University of Wisconsin appoints four, the Wisconsin Academy of Sciences, Arts, and Letters appoints three, 3) and the Department of Public Instruction and Milwaukee Public Museum each appoint one. Through its history, the council has been comprised of statewide experts in the disciplines of ecology, botany, geology, zoology, environmental education and communications. The council's role as an advisory body to the SNA Program has evolved significantly since its inception in 1951. SNA Program staff will continue to work closely with Natural Areas Preservation Council to redefine the council's purpose and relevancy, and to develop meaningful strategies to further the program's mission in light of strategic direction established by this strategy.

2.3.4 Outreach, Promotion, and Public Awareness

In the SNA Program's early decades, SNAs, then known as "scientific areas," were primarily the domain of university and agency researchers and a few citizens. The DNR did little to increase public awareness of the sites or foster their use. The need to provide more easily accessible SNA Program information grew with increased public environmental awareness, the rise of the Internet and demand for more places to explore nature. As public funding to acquire natural areas increased, so did efforts to raise public awareness of SNAs.

Marketing and promotion of NHC projects and programs, including the SNA Program, is critical to building and maintaining a constituency that will support SNAs into the future. Strategies used to promote program value and relevance include site descriptions, photos, and maps for all SNAs posted on the DNR website and a printed guidebook to SNAs, "Wisconsin Naturally," first printed in 2003. State natural areas are featured regularly in Wisconsin Natural Resources magazine and on social media platforms including Facebook and Instagram. Many SNA property field trips led by DNR staff and others are offered to the public through the Natural Resources Foundation of Wisconsin.

The SNA Program will continue to pursue innovative formats and venues to promote its mission, with an eye toward raising awareness among residents not familiar with these important public lands.

3. SNA Program Function

In the early years, sites for potential SNA designation were brought to the program for consideration by the scientific community, primarily university professors. SNA Program used — and still uses, with modification – the natural community classification developed by University of Wisconsin-Madison Ecologist John Curtis as the basis for determining "what to protect." Beginning in 1969 and ending in the early 1980s, the Program conducted a county-by-county inventory of natural areas. Investigators field checked pre-identified sites, documented their natural communities and ranked them from high to low quality. The NHI database was established in 1985 to provide a more rigorous and consistent protocol for documentation of rare species, natural communities and potential SNAs.

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Field Trip photos
SNA Web Page
WisNaturally photos

John Curtis Photo

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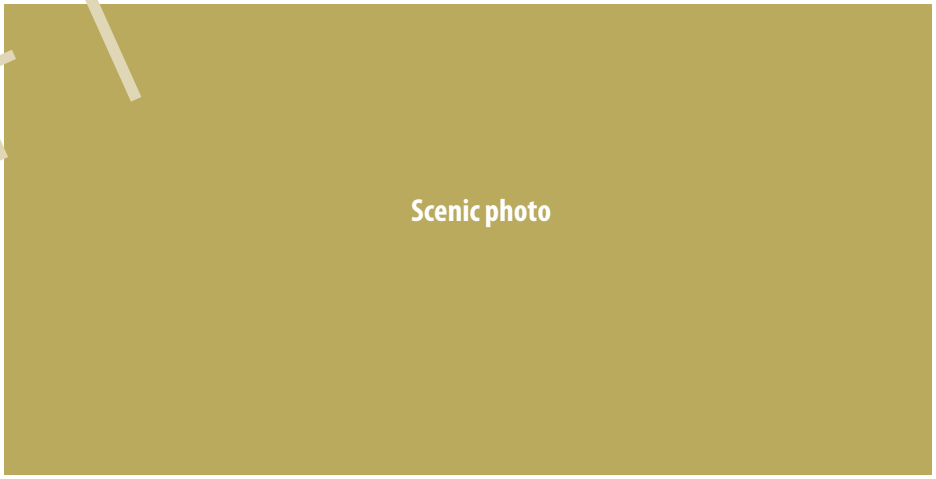

3.1 Designation and Withdrawal

As provided by state statute, SNAs may be established on property owned by public agencies, educational institutions and non-profit conservation organizations through **designation**, a process codified in DNR Manual Code 1750.1 (see Appendix 1). The designation of SNAs on lands owned by Program partners, including other federal, state, and local agencies, universities, and non-profit entities such as land trusts, is formalized through a Memorandum of Understanding between the partner and the DNR. State natural areas may not be designated on lands held by private individuals unless the DNR holds some manner of land rights to the property, typically in the form of a conservation easement.

The withdrawal of a SNA from the system has occurred very rarely, with only a handful removed across the program's history. Until development of this strategy, there was no formal written procedure for SNA withdrawal. In the future, sites proposed for withdrawal will be evaluated using an extensive analysis. The analysis (see Appendix 2) requires documentation of the reasons why the SNA no longer meets the standards for designation, and an explanation of why degradation of the site is irreparable and restoration impractical. Withdrawal proposals will be vetted using a new process (see Appendix 3) requiring consultation with the SNA Program and approval of the NHC Management Team, the Natural Areas Preservation Council, and the DNR Natural Resources Board. This procedure will eventually be codified in DNR Manual Code.

3.2 Dedication of State Natural Areas

With the passage of the Wisconsin Natural Areas Heritage Act of 1985 and State Statute 23.29, the legislature empowered DNR to provide long-term legal protection to previously designated SNAs through a process called dedication. Dedication is the unilateral declaration by the state that dedicated lands are to be held in trust in a manner which ensures their permanent protection as natural areas. It is the strongest form of land protection available in Wisconsin.

Dedication involves placing Articles of Dedication, a special type of conservation easement approved by the governor, on the property's title. The articles are permanently attached to the title and legally protect the land in perpetuity. They contain legally binding provisions for the stewardship, custody and protection of the natural values of the property and clearly define the covenants of the landowner and the state's rights. Both private and public land may be legally dedicated if it meets the evaluation criteria. With dedication, the landowner retains title to the property but gives up the right to conduct activities considered harmful to the natural values of the land. Dedicated land may never be taken for other uses and is protected from condemnation unless the Articles of Dedication are removed from the deed, which is a difficult and lengthy process stipulated in statute. The DNR must issue a written finding that the withdrawal of dedicated lands serves a "superseding and imperative public purpose" and no prudent alternative exists. Both the governor and the state legislature must approve the withdrawal. To date, no dedicated lands have been withdrawn from the SNA system.

Articles of Dedication

Dedication is the strongest form of land protection available in Wisconsin. Legally binding provisions for the stewardship, custody and protection of the natural values of the property are permanently attached to the title and legally protect the land in perpetuity.

Of the 691 SNAS, 97 DNR-owned and 56 partner-owned sites are protected through dedication.

As of 2020, there are 97 DNR-owned SNAs dedicated in whole or in part, and 56 partner-owned dedicated SNAs. Dedications have not been executed in recent years, resulting in a significant backlog of eligible lands awaiting dedication. The SNA Program remains committed to pursuing SNA dedication on eligible lands, focusing its efforts on higher priority parcels first and lower priority parcels second, as categorized below.

Attributes of first-priority lands to be dedicated:

- SNA lands administered by DNR's Bureau of NHC.
- SNA lands owned by non-profit conservation partners.
- DNR-owned SNA lands controlled by other bureaus or divisions containing regionally to globally rare natural community types.
- Parcels comprising the core of a SNA.
- Lands for which dedication is an administrative directive, a requirement of a grant, or a condition of acquisition.

Attributes of second-priority lands to be dedicated:

- SNA lands owned or controlled by entities other than those listed above.
- Lands requiring extensive title research or with disputable legal descriptions.
- Lands containing locally significant natural community types.
- Parcels comprising lands serving as buffer to the SNA.
- Parcels currently provided some additional measure of protection through rule, law, zoning, policy, or other, beyond state natural area designation.

3.3 Land Acquisition for State Natural Areas

State statute and DNR administration, with advice and approval of the Natural Resources Board, authorize the SNA Program to acquire land rights through fee title and easement transactions. This authority is granted to individually-named SNA projects and to an umbrella "Statewide Natural Areas Project." The Statewide SNA Project consists of 220 smaller (generally less than 500 acres) natural areas and is authorized to acquire a total of 41,000 acres. Additionally, there are 19 individually-named SNA projects, each with its own authority to acquire land. These are typically larger properties, with project boundaries ranging from 500 to 15,000 acres. With few exceptions, all land acquisitions must be made within administratively-approved project acquisition boundaries (see Figure 5). SNA acquisition boundaries are established to protect ecologically significant areas. The primary method to change previously approved acquisition boundaries is through DNR's master planning process (see Master Planning below).

Funding for land acquisition has been provided by a variety of state and federal programs. Since 1990, the Knowles-Nelson Stewardship Program, bonding-based funds allocated by the state legislature, has been the primary source for SNA land purchases. Other sources of acquisition monies are used opportunistically and include the U.S Fish and Wildlife Service through its National Coastal Wetland Conservation Grants, North American Wetland Conservation Act Grants and Cooperative Endangered Species Conservation Fund Grants. The Environmental Protection Agency's Great Lakes Restoration Initiative also has funded recent SNA acquisitions. Most federal grant programs require the state to provide matching funds — typically provided by the Stewardship Program, of 25% to 50% of acquisition costs. All DNR land acquisitions are pursued with willing sellers receiving appraisal-based fair market values.

Land is also acquired through donation of property rights (both fee title and easement) from individuals, corporations and non-profit entities. Land must meet SNA designation criteria and donations must be accepted by the Natural Resources Board.

There are many SNA projects in which land acquisition is at or nearing completion while others have acquired only a small number of acres or none. Although state funding for land acquisition has been reduced in recent budget cycles, the SNA Program remains committed to acquiring land by fee and easement within approved SNA project boundaries and corresponding to the protection priorities established in this strategy.

Large vs small SNA projects

Quincy

SEB

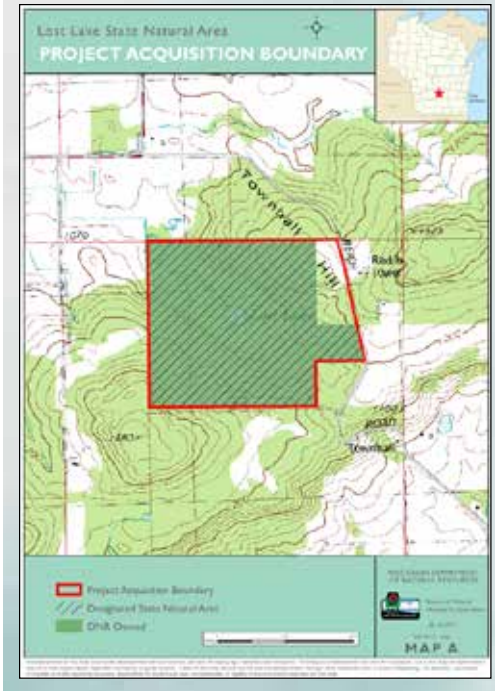

Figure 5. Example of a DNR project acquisition boundary map.

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3.4 Department Master Planning and State Natural Areas

A master plan is the controlling authority for all actions and uses on a state-owned property. The DNR develops master plans to describe and direct how its properties, including SNAs, will be used, managed and developed. A master plan also designates ecologically sensitive areas on the subject property and identifies how resource protection and management objectives will be balanced with public recreation. Before beginning the formal planning process, staff conduct a biotic inventory providing critical data for proposed area designations and decisions regarding future land use. Master plans receive public input and review at several stages before finalization and are revised every 15 to 20 years.

The majority of SNAs are designated as Native Community Management Areas (NCMA), a land classification that specifies management objectives for a property. NCMAs are managed to perpetuate native plant and animal communities and protect the biological diversity of native ecosystems. Management activities on NCMAs are designed to achieve management objectives through natural processes or techniques that mimic natural processes. Traditional recreational uses such as hiking, hunting, fishing, trapping and nature appreciation are nearly always allowed on these management areas, although rarely SNAs may be closed to protect a rare species, sensitive habitat, or to ensure public safety.

The master planning process is also used to designate new "embedded" SNAs on lands the DNR already owns, including wildlife areas, state forests, and state parks. Sites of potential natural area quality identified during the biotic inventory are considered for designation if they meet establishment criteria and program priorities. Moving forward, this strategy's guiding principles will be used to determine if a site qualifies for SNA designation.

The master planning process is also used to expand or contract boundaries previously established for SNAs. In addition, previously established SNAs may be proposed for withdrawal if the site is determined to no longer meet establishment criteria. Projects also may be proposed for elimination if new data reveals they are no longer viable or needed for conservation purposes. During the master planning process, this strategy's guiding principles will be used to evaluate all existing SNA project acquisition boundaries to determine if any warrant elimination or modification.

3.5 Forest Certification and State Natural Areas

All DNR-managed lands (forested and non-forested), including SNAs, are dual-certified as being responsibly and sustainably managed under standards set by two independent, third-party bodies, the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI). SNAs on county-managed lands are also certified by one or both organizations. Forest certification ensures management of state-managed land meets standards for ecological, social and economic sustainability. Certification requires annual field audits to ensure compliance with these standards. FSC standards are generally more restrictive, so conforming with these standards typically meets Sustainable Forestry Initiative standards as well (see Forest Stewardship Council – US 2019). The SNA Program contributes significantly to fulfilling these standards for DNR-managed properties.

The Forest Stewardship Council has developed 10 Principles and 57 Criteria that apply to FSC-certified lands, several of which relate closely to the SNA Program. For example, Principle 6 includes a criterion specifying that representative samples of existing native ecosystems across landscapes are protected in their natural state. State natural areas meet this criterion because they represent natural communities present across each of the Wisconsin's ecological landscapes at the time of European settlement. As another example, Principle 9 requires the state determine the presence of attributes consistent with High Conservation Values on state lands. There are six types of High Conservation Value lands and the SNA Program have developed criteria for selecting sites that fit the definition. State natural areas fulfill requirements for four of these types and comprise the majority of High Conservation Value lands in Wisconsin.

Boosting Wisconsin's Forest Economy

One million acres of state-owned land are certified as responsibly and sustainably managed under forest certification standards set by independent bodies. Such certification helps Wisconsin forests remain competitive in global markets that increasingly demand certified raw materials. Publishers, building contractors, other manufacturers and governments are expanding use of certified wood, and that translates into jobs and income for Wisconsinites.

State Natural Areas play an important role in maintaining DNR forest certification. SNAs are certified and help DNR meet standards in the required high conservation value category.

4. Public Use of State Natural Areas

4.1 Public Access and Recreational Use

Nearly all DNR-owned SNAs are open to the public except for a handful closed to protect features or species deemed too sensitive for public visitation. Access and allowable uses on these sites are governed by policy, administrative rule, Natural Areas Preservation Council guidance, and provisions set forth in property master plans. The permissible uses of SNAs owned by non-DNR partners varies by landowner and are difficult to quantify and characterize them given their sheer number, statewide distribution, diversity of features and variety of ownership. In addition, unlike other public lands such as state parks, SNAs lack on-site staff to monitor uses and user numbers. Incidental observations suggest the most common recreational uses of SNAs are hiking, nature study, photography, hunting, fishing and foraging. Public use and the diversity of those uses has increased as Wisconsin's population and awareness of SNAs as places to recreate has grown. Public requests to access SNAs for currently prohibited and incompatible uses such as motorized and non-motorized vehicles, rock climbing, geocaching and horseback riding have likewise increased.

Herein lies a program conundrum: heightened public awareness of SNAs may help build allies and advocates for these properties, yet increased visitation also has the potential to degrade these sites. While increased visitation and associated site degradation are not as significant as the statewide environmental challenges detailed later in this document, incompatible or excessive public use is a growing concern. Developing sound justification and policy for the types and intensity of activities allowed is needed, in conjunction with building capacity to effectively enforce rules to deter incompatible or illegal activity.

When considering requests from the public that deviate from established SNA use policy, the SNA Program will evaluate the potential for detrimental impacts, considering potential negative effects on flora, fauna, soils, geological features, air and water resources and sound and visual aesthetics. The evaluation also will address the potential for user conflicts. Consideration of the resources required to accommodate an activity, including facility development, enforcement and property management also must be part of the analysis. See "SNA Categorization" section below for an example of one way in which the program will address this issue.

4.2 Research and Education at State Natural Areas

Developing a system of permanently protected lands available for the study of Wisconsin's native plants, animals and natural communities was one of the primary reasons for creating the original Scientific Areas Program. Although the SNA Program fully supports formal research on SNAs, it has not actively promoted that use to the scientific community. Most research done on SNAs comes from outside DNR. Investigators are required to hold a State Natural Area Research and Collecting Permit (DNR Form 9400-280) for any activity requiring specimen collection or for any research other than simple observational studies. Program staff issue an average of 40 permits annually for a diversity of research projects. Most permits are issued to graduate students and instructors affiliated with University of Wisconsin System campuses. Permittees are required to provide reports after the project ends.

SNAs provide outdoor education venues for students to benefit from inquiry-based learning, place-based learning and systems thinking. Research suggests student engagement with the natural world enhances wellness, health and positive environmental attitudes. Since SNAs are widespread in Wisconsin, they provide opportunities for educators and students to make nearby connections to nature and enhance student learning.

Non-research educational use of SNAs by secondary schools and universities as "outdoor classrooms" is known to occur regularly but has not been quantified. Several schools offer citizen-based science projects and field courses focused on plant and animal ecology and earth sciences that incorporate SNA visits into their curriculum. SNA Program staff realize that the educational and scientific communities are not necessarily aware of SNAs as places for research and outdoor learning and will work to raise the profile of SNAs for those uses.

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People Recreating

Hike, hunt, nature study

FT Pix?

Researchers
Students

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Burn
Brush
Invasives work photos

5. Natural Community Management at State Natural Areas

Since its inception in 1951, the SNA Program has largely focused on protecting and managing some of the best examples of Wisconsin's native plant communities present before intensive European settlement in the in the mid-1800s. Maintaining fire-dependent communities including oak savanna, prairie and barrens has been the long-term program goal. At present, the SNA Program manages approximately 6,000 acres with prescribed fire per year on state-owned lands and almost as many acres using mechanical and chemical treatments.

For many SNAs with forested communities, including, northern mesic or wet-mesic forests, maintaining a late seral stage has been the primary management goal. The clear cutting of Wisconsin's forests ("the cutover") and subsequent wildfires during the turn of the 19th century drastically altered the age-class distribution, composition and structure of Wisconsin's northern forests. The cutover was so pervasive that actual old growth (typically natural origin, uneven-aged stands older than 150 years with canopy gaps and abundant course woody debris) forests are rare in Wisconsin today. Today, many forested SNAs with stands between 120 and 150 years old are passively or minimally managed with silvicultural techniques designed to re-establish old-growth conditions. Many wetland types, including northern Wisconsin peatlands, are also passively managed.

Natural community management requires ecologists to treat each site individually based on numerous factors such as management goals and objectives and the primary protected feature for the property. Regardless of whether management is active or passive, or the natural community type is early or late-successional, invasive species control is a necessary aspect of the maintaining the ecological integrity of a site's natural communities. On SNAs protected for concentrations of rare species, management for those rare species takes precedence, relegating natural community management to a secondary objective. Currently, the SNA Program's ability to reach management goals for these sites is limited by resources in certain regions and natural community types.

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Ecological Integrity

Air photo for context

Ecological integrity is defined as "the structure, composition, and function of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historic disturbance regimes" (Parrish et al. 2003, Faber-Langendoen et al. 2016). Ecological integrity builds on related concepts of biological integrity and ecological health.

Evaluating ecological integrity involves establishing specific measures that inform us about the status of an ecosystem.

Primary ecological factors are:

- **Condition of the ecosystem**. The structure and composition of site vegetation, including proportion of native species, invasive species, relative amount of native weedy species, conservative species, structural complexity, woody regeneration, snags and coarse woody debris, and soil disturbance; for wetlands, hydrologic integrity is also evaluated;
- **Landscape Context**. The land use or land cover surrounding an ecosystem. Natural areas like forests, prairies, and wetlands are better able to buffer a SNA from runoff, invasive species, and other edge effects compared to non-natural habitats like roads, development, and agricultural fields.
- **Size**. Size matters, especially for species requiring large blocks of contiguous habitat. Large blocks of habitat also tend to support a greater number of species overall, and species present have healthier populations due to more available habitat and fewer edge effects such as invasive species, predators and nest parasites like cowbirds.

For each of these factors, key metrics are selected that are responsive, practical, cost-effective and well-tested in measuring the condition of the ecosystem. Metrics also integrate known stressors that affect these major ecological factors. Collectively these can be used to can help guide management decisions to maintain or restore ecological integrity.

Ecological integrity has great value for the SNA Program, which strives to be a network of minimally disturbed or "reference" sites. Using standardized ecological factors for each of the major types of communities (wetlands, prairies, forests, etc.) provides a consistent way to evaluate the current condition as well as management effectiveness over time. It can be a component of inventory and monitoring of ecosystem condition and helps set ecological performance standards to assess site-specific and regional restoration projects. The approach was formalized and used by NatureServe, the non-profit umbrella organization for natural heritage programs in the Western Hemisphere, as well as by the National Park Service to provide information to improve management of biological resources and maintain a broad ecosystem-based framework.

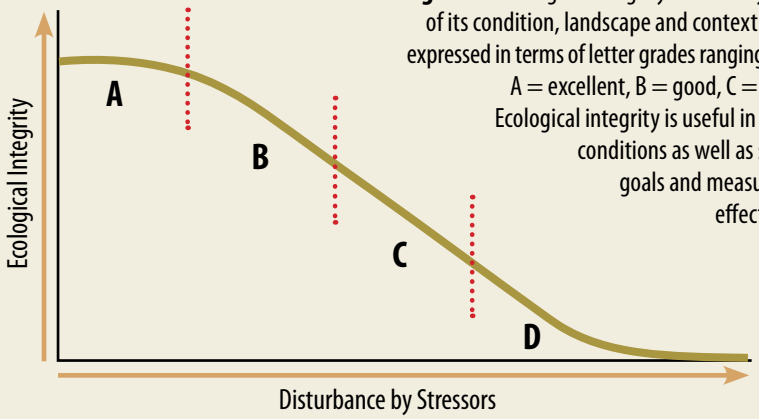

Figure 6. Ecological Integrity of an ecosystem is a function of its condition, landscape and context size, and is usually expressed in terms of letter grades ranging from A through D. A = excellent, B = good, C = fair, and D = poor. Ecological integrity is useful in evaluating current conditions as well as setting restoration goals and measuring management effectiveness over time.

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Statewide Environmental Challenges

6. Environmental Challenges Facing State Natural Areas

The increased number, extent and intensity of environmental challenges are one of the main issues affecting the future of the SNA Program in Wisconsin. These stressors limit our ability to manage the system of State Natural Areas to achieve the original goals of maintaining plant communities present before European settlement of Wisconsin. While there are many environmental challenges, the following six stressors have the greatest negative impact on biodiversity and are the most widespread, affecting all or a large majority of sites.

6.1 Habitat Loss and Fragmentation

Since statehood in 1848, Wisconsin has experienced significant conversion of natural habitats to accommodate a growing human population and their land uses, resulting in the loss, fragmentation and alteration of biotic communities (Figures 7 and 8). These changes are particularly prevalent in the southern half of Wisconsin, particularly for easily farmed and grazed communities like prairies and savannas. Over 99% of prairie and savanna acreage has been lost since the mid-1800s (Hoffman 2002), resulting in the declines of many species dependent on these habitats. Even where patches of habitat remain, fragmentation results in deleterious impacts to species and natural communities by constraining species movement, impacting population viability, accelerating the spread of invasive species and magnifying impacts from overabundant meso-predators like raccoons and coyotes. In addition, small habitat patches are susceptible to species loss, a phenomenon predicted by the theory of island biogeography (MacArthur and Wilson 1967) and confirmed by recent empirical long-term studies (Alstad et al. 2016).

Fragmentation due to agriculture and urban or suburban development can influence management of natural communities. State natural areas near urban areas are subject to pressures including abundant invasive species, storm water runoff and high levels of public use. Indirect impacts such as public opposition to management techniques including herbicide use, prescribed fire and timber harvest are not uncommon and make management challenging. With population in Wisconsin projected to grow 14% from 2010 to 2040, impacts associated with habitat loss and fragmentation are expected to increase (Radeloff et al. 2010).

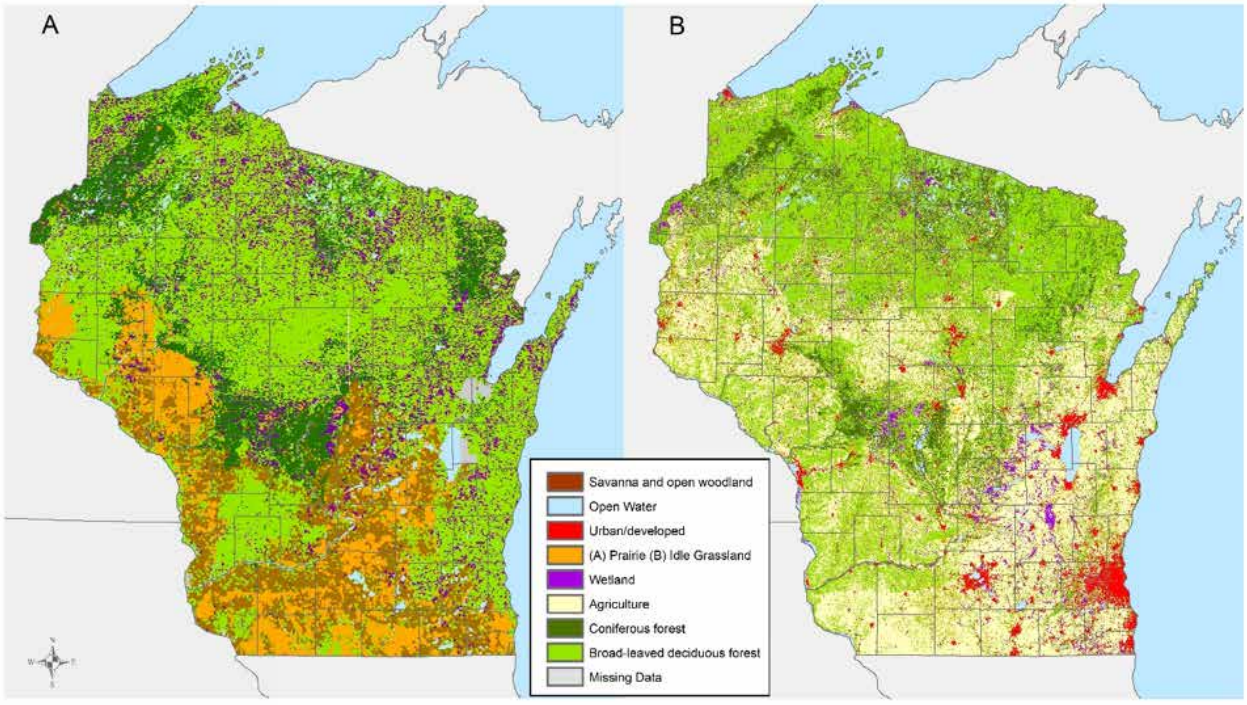

Figure 7. A, B. Vegetation and land cover change in Wisconsin from the mid-1800s to the 1990s. Figure A: Generalized pre-European vegetation classes derived from U.S. Government Land Office Survey data 1832-65 (©D. Mladenoff). Figure B: Current generalized vegetation and land cover classes derived from Landsat satellite data (Wisconsin Department of Natural Resources, Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and data, 2010). Figure A courtesy of David Mladenoff, University of Wisconsin-Madison. Used with permission. Both A. and B. adapted cartographically by Bill Ceelen, DNR Bureau of Technology Services.

Where feasible, the SNA Program will address impacts of habitat loss and fragmentation by working with conservation partners at larger scales; identifying and establishing buffers around sites for acquisition and to ameliorate impacts of invasive species; and by working with partners to establish and maintain linkages between habitat patches, especially in anticipation of species' range shifts resulting from climate change (Anderson et al. 2018).

6.2 Altered Natural Disturbance Regimes

Since European settlement, altered natural disturbance regimes have had significant impacts on the structure and composition of Wisconsin natural communities. Altered disturbance regimes include fire suppression by settlers and the cessation of intentional fires set regularly by Native Americans before European settlement (Denevan 1992, Nowacki and Abrams 2008, Hanberry and Abrams 2018). Hydrologic modifications including drainage of wetlands and damming of rivers for flood control are other examples of altered natural disturbance regimes.

Fire Suppression and Natural Community Conversion. Following repeated, devastating fires during the cutover period, fire suppression became de facto policy in Wisconsin. The recognition that fire is essential to sustaining fire-adapted communities such as prairie, oak savanna, oak and pine forests didn't become mainstream until the 1980s and even since then, use of prescribed fire has been limited to relatively small areas.

Widespread fire suppression has resulted in the conversion of prairies and savannas to low-quality shrublands and forests and shifted species composition from fire-dependent species such as oaks and pines to fire-intolerant species like red maple and basswood. In addition to having a more closed canopy, many of these fire-intolerant species exacerbate shading in the understory by blocking more available sunlight. Successful oak and pine regeneration requires an open canopy with direct sunlight, without adequate light a wholesale forest type conversion may result without widespread intervention. Fire suppression also has also negatively impacted savannas and prairies as woody species encroach and shade out light-dependent species, most notably grasses and forbs. Their loss is especially problematic for specialized invertebrates depending on specific host plants. For example, the federally endangered Karner blue butterfly requires lupine, which thrives only in the semi-open conditions of fire-dependent pine and oak barrens.

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Altered Natural Disturbance Regimes

A change in patterns of frequency, timing, duration and spatial extent of natural ecological processes such as fire, flooding, insect outbreaks and wind events that affect the development and maintenance of ecosystems and landscapes in a particular area.

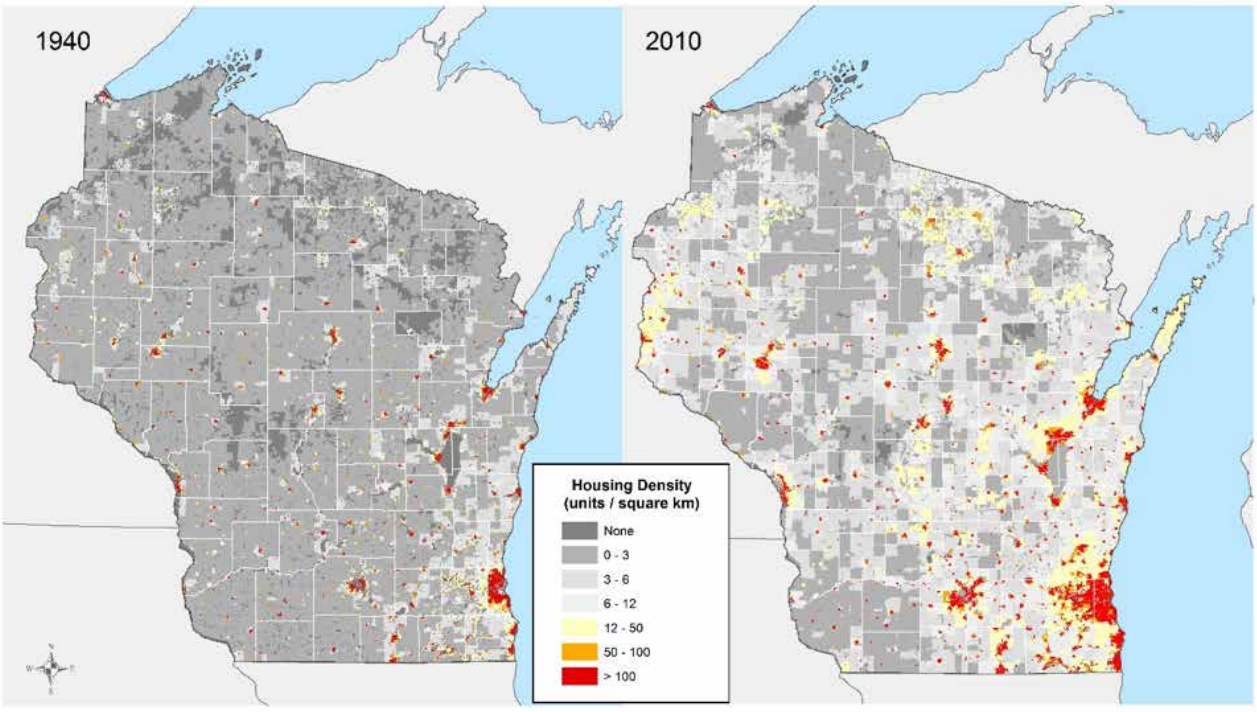

Figure 8. Housing density in Wisconsin in 1940 and 2010. Data from V. Radeloff, Silvis Lab, University of Wisconsin-Madison (Radeloff et al. 2010). Cartographically adapted by Bill Ceelen, DNR Bureau of Technology Services.

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Ditched wetland photo

GM Buckthorn

Hydrologic Alterations. Natural riverine flooding regimes have been altered by dams and levees, especially on large river systems like the Mississippi and Wisconsin. Natural communities upstream of dams have been inundated while downstream, changes in the magnitude, duration and timing of flooding has resulted in subtle but profound effects on floodplain forests, sandbars, marshes, sedge meadows and prairies. Managed river systems typically have lower peak flows, allowing flood-intolerant plants to invade portions of floodplains, and higher base flows, which leave fewer mudflats and sandbars exposed long enough for pioneering species like cottonwood and river birch to establish. The overall impact is analogous to fire suppression and results in ecological simplification of natural communities.

Other hydrologic alterations such as ditching have profoundly affected wetlands throughout much of the state, contributing to the loss of more than 50%, or 5 million acres of wetland in Wisconsin since European settlement. More recently, excessive withdrawal of groundwater has resulted in locally significant impacts to groundwater-dependent wetlands like fens. Ditching and excessive groundwater extraction can lower water tables, leading to the loss of peat soils and an increase in weedy or non-wetland plants.

6.3 Non-native Invasive Species

Non-native invasive species are one of the leading threats to Wisconsin's SNAs and the rare and endangered species they harbor. Examples include plants such as garlic mustard, buckthorn and Eurasian water-milfoil, vertebrates such as wild pigs, invertebrates including emerald ash borer and non-native earthworms, and diseases such as Dutch elm disease.

Non-native invasive species often thrive in newly disturbed areas and invade adjacent high-quality natural areas. They establish quickly, spread easily, tolerate a wide range of conditions and are relatively free of the diseases, predators and competitors that kept their populations in check in their native range. Non-native invasive plants can out-compete and even kill native plants by monopolizing light, water and nutrients. They also can alter soil chemistry and mycorrhizal relationships. In situations where non-native invasive plants become dominant, they may alter ecological processes by limiting use of prescribed fire, modifying hydrology, limiting tree regeneration and ultimately impacting forest composition. In addition to the threats to native communities and native species diversity, non-native invasive species harm forestry by reducing tree regeneration, growth and longevity. They can hamper recreation and agriculture and threaten human health by causing skin rashes and increasing incidence of tick-borne diseases. Non-native invasive plants and animals also can harm fish and wildlife species by displacing native food sources and diminishing habitat for ground-nesting birds.

The challenges of invasive species are likely to increase as environmental factors favor their continued range expansions. For example, the emerald ash borer is predicted to continue spreading and make wholesale changes to ash forest types across Wisconsin, presenting significant challenges where a forested condition is the long-term goal. Ash forests may be replaced by shrubs and invasive plants like reed canary grass.

The frequent use of some SNAs for recreation increases the risk of introduction and spread of non-native invasive species. Parking, trails and other high-use areas are typical entry points for non-native invasive species carried in on visitors' footwear, clothing, pets, vehicle tires, boats and recreational equipment. Once established, invasive species may continue to spread along natural corridors like waterways and along human-made corridors like trails and roads. Invasive species also have the potential to invade more remote natural areas, carried along by wind, water and wildlife. Non-native invasive species also may be spread inadvertently through DNR management activities, especially if Best Management Practices are not followed.

No part of Wisconsin will be free from the pressures of invasive species and disease in perpetuity, however, resilient lands and larger sites where the SNA Program and its partners have land management authority will provide the best opportunities to manage invasive species to protect the ecological integrity of the native plant communities.

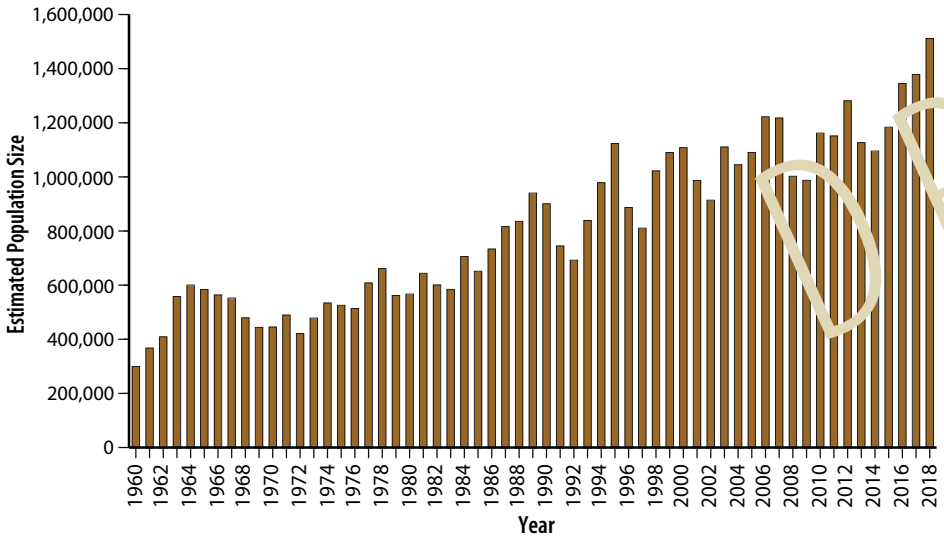

Figure 9. Statewide post-hunt white-tailed deer populations show a dramatic increase from 1960 to 2018. (Wisconsin DNR, unpublished data).

6.4 Over-abundant White-tailed Deer

High deer numbers have become a management challenge for Wisconsin forests as well as much of eastern North America. Browsing by white-tailed deer can dramatically impact the composition, structure and function of ecosystems, especially when they are present in high numbers (Waller et al. 2009, DNR 2015b). Wisconsin's deer population is dramatically higher than it was during European settlement and has been at prolonged high levels in much of the state since the 1980s (Figure 9). Overly abundant deer can negatively impact herbaceous plants, tree regeneration, birds, mammals, herptiles and other animals, as well as exacerbate the spread of invasive species. Waller et al. (2009) and Wisconsin DNR (2015b) offer a more thorough discussion of the impacts of deer.

Nearly all DNR-owned SNAs, 99% by both number and acreage, are open to hunting and trapping with few exceptions. Deer hunting is especially encouraged to reduce impacts to sensitive vegetation.

Browseline

browsed understory

Winter deeryard

Whitetail

6.5 Nitrogen Deposition and Phosphorous Enrichment

Most terrestrial natural ecosystems and native plants in Wisconsin are adapted to, and are more competitive in, low-nitrogen environments. However, atmospheric deposition of nitrogen in Wisconsin has increased an estimated 10 to 30 times relative to natural rates over the past two centuries. This high nitrogen environment fuels increases in nitrogen-loving plants, which are generally weedy or invasive species (Galloway et al. 2008, US EPA 2019), at the expense of desirable, more conservative, native species.

Increases in available nitrogen results from two sources: the conversion of inert nitrogen gas (N_2) to ammonia (NH_3), primarily for use as a fertilizer, which is then volatilized from agricultural systems, and the burning of fossil fuels, which produces nitrous oxide (N_2O).

Ammonia and related compounds from agricultural sources (Figure 10) are the primary source of excess nitrogen in Wisconsin and the rest of the Upper Midwest, constituting over 75% of total nitrogen deposition (Li et al., 2016). These reactive nitrogen compounds are deposited from the atmosphere onto natural landscapes through both dry deposition and dissolved in rain or snow, where they substantially increase nitrogen available for plant growth.

As nitrogen availability increases, biotic community structure and composition changes, causing shifts from desirable native species to weedy species, especially in grasslands, bogs, shallow, soft-water lakes and some forest ground layers (WallisDeVries and Bobbink 2017, Perring et al. 2018). Increased nitrogen also benefits invasive plants and non-native earthworms, and in grasslands makes prescribed fire more difficult as native grasses are replaced by shrubs and weedy forbs (Pardo et al. 2011). The changes affect the full suite of plants and

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related lifeforms, including diatoms, lichens, mycorrhizal fungi, herbaceous plants, shrubs and trees (Pardo et al. 2011). Nitrogen deposition also alters nitrogen cycling, productivity and soil chemistry by increasing acidity and reducing calcium and other nutrients necessary for certain plants (Pardo et al. 2011). Other impacts include physiological and nutrient imbalances, and increased susceptibility to secondary stresses like pests.

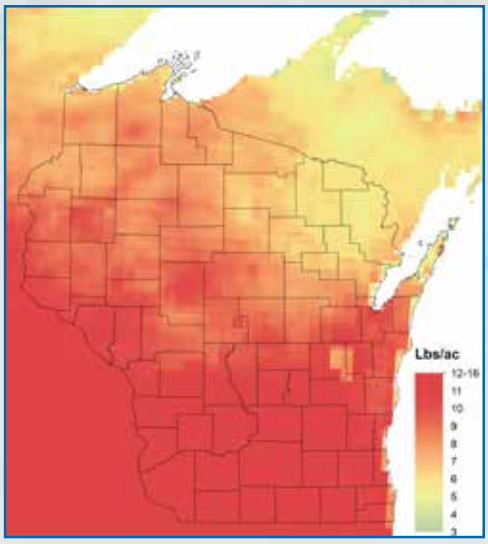
Phosphorus enrichment poses a similar challenge, particularly in oligotrophic wetland and aquatic systems which are naturally low in phosphorus availability (Downing and McCauley 1992). Once in an aquatic system, phosphorus increases algae growth, including toxic blue-green algae, and subsequently leads to oxygen depletion when algae die and decompose, threatening fish and other aquatic life. Phosphorus enrichment also has been shown to accelerate the conversion of sedge meadows to cattail marsh (Woo and Zedler 2002).

Excess phosphorus enters lakes and wetlands from several non-point sources, including agricultural fertilizers, feedlot runoff, and urban storm water drainage (Downing and McCauley 1992). Spreading agricultural manure to frozen ground and just before rapid snow melt and spring rain is particularly problematic, as nutrient-laden water runs off fields before plants can take it up (Lee 1973). Phosphorus from point sources such as chemical detergents and wastewater treatment plants has been substantially reduced over the past 50 years and is no longer a leading source of phosphorus pollution.

Phosphorus is especially problematic because it tends to bind to soil particles in streambeds and lake sediments and can be re-suspended into the water column when sediments are disturbed by floods, dredging or carp. This legacy phosphorus can continue to cause toxic algae blooms and eutrophication-related issues for decades, even after initial sources have been reduced or eliminated. Excess nitrogen also can be problematic in aquatic systems, as it is also a limiting factor for plant growth some aquatic environments and at certain times of year (Lee 1973), thus also causing excess growth of aquatic weeds.

Nitrogen deposition and phosphorus enrichment are serious environmental challenges. While management such as prescribed burning and grazing can counter the most deleterious effects of increased nitrogen and improve short-term habitat suitability, it does little to slow or to reduce the amount of nitrogen accumulating in soil pools at current deposition rates (Jones et al. 2017). Similarly, excess phosphorous is likely to hamper efforts to restore sedge meadows and instead will continue to fuel expansion of cattails over more desirable plants. Climate change has the potential to exacerbate these nutrient related impacts to plant communities due to as longer growing seasons, increased precipitation and carbon dioxide fertilization will further fuel undesirable plant growth.

Figure 10. Ammonia deposition from sources dissolved in precipitation in 2017 (US EPA 2019). Much of southern Wisconsin receives 10 to 30 times more nitrogen per year, mostly from agricultural sources compared to natural deposition rates, causing wholesale shifts in plant and animal communities.



6.6 Climate Change

The climate is changing. The current rate of climate change is roughly 10 times the average rate seen during recovery from historical ice ages (Anderson et al. 2018). Average global temperatures continue rising, with each year often among the highest ever recorded in human history. By the end of the 21st century, Wisconsin's climate is projected to resemble Arkansas'. These changes will have profound impacts on the plants, wildlife, and ecosystems that currently thrive in Wisconsin.

Many of these impacts are already happening. Wisconsin winters are warming (Kucharik et al. 2010) along with observed declines in the thickness and duration in lake ice (Hewitt et al. 2018), soil frost (Sinha et al. 2010), and snowpack (Kunkel et al. 2016), despite locally increased snowfall in snowbelt regions (Andresen et al. 2012). This impacts not only species but also management that requires frozen ground, like timber harvests in forested wetlands or brush mowing on soils sensitive to compaction (Janowiak et al. 2014). Extreme weather is dramatically increasing, particularly very large precipitation events.

Phenological studies show that plants and animals are emerging earlier in the spring (Bradley et al. 1999) and killing frosts are occurring later in the fall (Kucharik et al. 2010), which can cause phenological mismatches between flora and fauna, favor invasive species, and alter traditional prescribed fire windows (WICCI 2011, 2017). Migrating birds may arrive in Wisconsin before insects and plants are available to feed them, and early springs can cause pollinator to emerge before their food is available, while summer drought and warmer temperatures can cause host plants to senesce before butterfly and moth larvae have fully developed.

Climate change will affect Wisconsin plants and animals, but not all species are affected equally. Although some highly mobile species, including some birds and generalist mammals, ranges are shifting northward, many species cannot migrate fast enough, face major barriers to migration in fragmented landscapes, or in some cases, have no suitable habitat to move to. Climate change is already having serious implications for conservation, and the impacts are expected to increase significantly by 2030-2040 (IPCC 2014).

6.6.1 Temperature

Wisconsin temperatures have risen ~2°F since the beginning of the 20th century, and temperatures in the 21st century have been warmer than any other period in human history (Frankson et al. 2017). They are expected to increase even more by the end of this century, with likely significant repercussions for Wisconsin SNAs and the rare species relying on those sites.

The average daily mean temperature in Wisconsin is projected to warm 4 to 7°F by the middle of this century and 5 to 11°F by the year 2100 (Alder and Hostelter 2013). This increase is not evenly distributed seasonally or regionally. Northern Wisconsin is projected to warm more than southern Wisconsin, while the least warming is expected along Lake Michigan due to the ameliorating effect of the Great Lakes.

Seasonally, Wisconsin is becoming "less cold," with the greatest warming projected to occur in winter and spring (WICCI 2011). Nighttime temperatures are projected to increase more than daytime temperatures throughout the year. There will be fewer very cold days and extreme cold events. Correspondingly, there will be fewer days of lake ice and reduced duration of snowpack and frozen ground conditions. The warming of the shoulder seasons will result in longer growing seasons. And while summer will only be somewhat warmer on average, it will produce more frequent and hotter extreme heat events. Warmer temperatures also will increase evapotranspiration, increasing the potential for soil moisture stress and drought conditions in summer.

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Wisconsin's Changing Climate

Projections call for:

- *Warmer winters and year-round nighttime temperatures leading to decreased snowpack and shorter duration of frozen ground conditions.*
- *More precipitation, especially during winter and spring.*
- *More extreme precipitation events.*
- *More frequent hot summer days, heat waves and dry periods.*
- *Increased likelihood of soil moisture stress in summer.*

Vulnerable species like northern forest

trout streams

migratory birds

DRAFT

6.6.2 Precipitation

While precipitation can vary widely year to year, long-term trends clearly show Wisconsin is experiencing an increase especially in winter and spring. The frequency and intensity of heavy rains also has increased significantly over the past several decades (Figure 11, Frankson et al. 2017). At least six "500- to 1000-year storms" occurred in Wisconsin between 2008 and 2018 based on analysis of National Weather Service storm summaries and NOAA's Precipitation Frequency Data Server (Perica et al. 2013, NOAA 2017). These intense rains have significantly damaged natural systems and infrastructure.

Precipitation is projected to increase as much as 4 to 5 inches annually by the end of the century, with most of the increase in winter and spring (Frankson et al. 2017). Warmer winter temperatures also increase the likelihood precipitation will fall as rain instead of snow, potentially increasing erosion as more rain falls outside the growing season before plants can absorb some of the runoff. Due to earlier snow melt, peak flows in streams are expected to occur earlier, potentially with increased flashiness. Summer is projected to be slighter drier and fall slightly wetter. While there is a high degree of uncertainty associated with these seasonal projections, there is a high likelihood Wisconsin will experience more frequent and more intense heavy rains.

6.6.3 Climate Change Vulnerability and Implications for the Wisconsin SNA Program

Climate change will not affect all species and communities equally. Climate change vulnerability assessments estimate the degree of risk a species or community faces from climate change. For communities, vulnerability means the risk of significant changes in plant species composition, vegetative structure, community identity, and extent on the landscape due to direct or indirect climate impacts. Climate vulnerability was assessed for most major natural communities of Wisconsin using a range of low to high change scenarios by the year 2100 (Janowiak et. al. 2014, WICCI 2017). Between one-third (low- change scenario) and more than half (high-change scenario) of the known high-quality natural communities were determined to be highly vulnerable to climate change (Janowiak et. al. 2014, WICCI 2017). This means that by 2100, a substantial portion of natural communities on SNAs are likely to experience significant changes in their composition, structure and community identity even under a low-change scenario with the same level of management. This high degree of risk necessitates major adjustments to the future direction of the SNA program.

6.7 Difficulties of Setting Conservation Targets Using Historical Reference Conditions

6.7.1 Gap Analysis: The Concept of Representation

A significant component of the SNA Program's mission is the concept of representation: protecting and managing representative examples of high-quality natural communities across the state in the ecological landscapes where they historically occurred. Having geographical

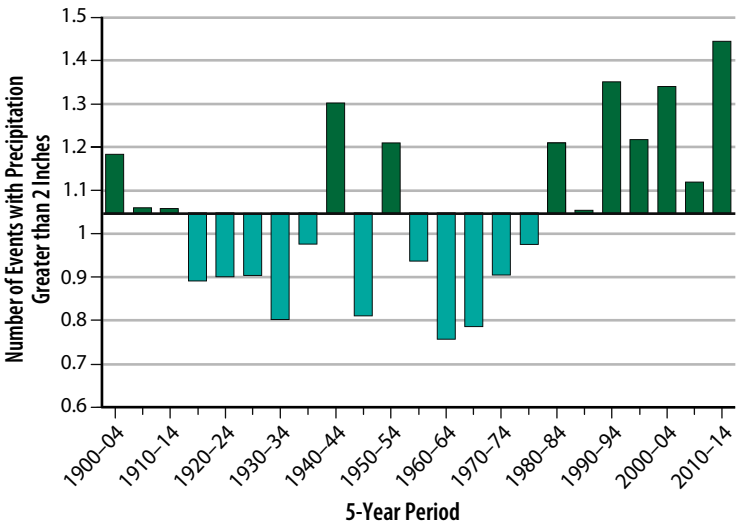

Figure 11. Since 1990, Wisconsin has experienced an increasing number of extreme rain events in which precipitation exceeded 2 inches. These values are averages from 28 long-term reporting stations. Source: CICS-NC and NOAA NCEI (Frankson et al. 2017).

representation among regions and replication within regions is important because not every species occurs at every site, even if the same natural community types are present. In addition, there can be genetic diversity between sites and regions. Geographical representation is also important because there can be differences in the microclimatic and soil conditions between sites that affect plant growth, species composition and resilience of the plant and animal communities; and because challenges vary by ecological landscape. Protecting multiple examples of a given natural community ensures that a more complete array of biological diversity is conserved, better fulfilling the program's mission. Protecting multiple representative examples also helps ensure long-term biodiversity conservation in the event that some sites become degraded due to environmental stressors.

Since the 1990s, the number of sites needed for adequate geographic representation and protection has been determined through a Gap Analysis, which was based on major ecological divisions established according to the National Hierarchical Framework of Ecological Units across the state (Cleland et al. 1997). While the Gap Analysis has been foundational to the Wisconsin SNA program, growing environmental challenges mean this approach alone is insufficient to protect the full spectrum of Wisconsin's native biodiversity into the future.

6.7.2 Non-stationarity and the Problem of Historical Reference Conditions

The concept of ecological representation is often viewed through the lens of conserving examples of pre-settlement plant communities. Similarly, SNAs often serve as benchmarks or reference sites for restoration and management efforts, implying that the goal is to restore sites to conditions before degradation occurred following European settlement.

Using historical reference conditions to determine protection and management goals assumes that the past condition is a good gauge for the future. This assumes that environmental conditions and ecological processes are relatively unchanging over time, a concept known as "stationarity." However, many examples of shifting conditions and processes, ranging from altered natural disturbance regimes to deer densities to nitrogen deposition to climate change show this to now be a false assumption. Comparisons of plant communities over the past 60 years reveal that even high-quality sites that have received significant management attention have changed and shifted away from historical conditions not just since the 1800s, but from the 1950s to early 2000s (Leach and Givnish 1996, Rogers et al. 2008, Alstad et al. 2016). If future environmental conditions are not similar to past conditions, attempting to maintain or return sites to historical conditions may be impossible or unsustainable (Safford et al. 2012). This concept of non-stationarity—that important environmental conditions and drivers are changing over time — necessitates a shift in how historical reference conditions are used, especially in a management context. Historical reference conditions will still be useful, but it is more appropriate to view them as ***waypoints*** or interim targets, rather than as restoration ***endpoints*** (Safford et al. 2012).

7. Recreation as an Emerging Issue

While not yet considered a ***statewide*** challenge equaling previously discussed stressors, public desire to use SNAs for recreational activities inconsistent with safeguarding these sites is a localized issue of concern that appears likely to expand. With very few exceptions, virtually all SNAs are open to the public, and we encourage their use for low impact activities such as hiking, bird-watching, hunting, nature exploration and outdoor education. However, there have been an increasing number of requests to open areas to activities such as horseback riding, mountain biking, rock climbing and off-road vehicle use, and problems with people using SNAs as gathering spots. Lulu Lake and Pewit's Nest, for example, have become destinations for social gatherings due to the presence of attractive aquatic resources. Requests for facilities to support these activities, including restrooms, developed trails or boat launches and campgrounds, are likely to increase.

Many of these requests are incompatible with the statutory responsibility and goals of the SNA Program. Other state and public lands allow for these types of activities — state parks, state forests, multi-use recreation trails and more. Distinguishing between what are, and are not, acceptable uses on SNAs will likely require further delineation of what types of activities are acceptable, on what types of sites, when during the year, and perhaps what kind of SNA category.

Overuse of like Pewitts Nest

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Generic Natural Community

Future of the SNA Program

The stressors and emerging challenges to Wisconsin's natural communities and rare species, particularly climate change, raise questions about what the SNA Program will look like in the future. Questions include: what will the suite of Wisconsin's natural communities look like in 25, 50, 100 years and beyond? Will current approaches to managing natural communities and rare species need to change, and if so, how? Will the pace of climate change impacts and natural community conversion increase, slow, or stay steady? What will it mean to maintain ecological reference areas? Will the DNR and partners be able to facilitate protection and management of natural resources at sufficiently large scales given the increased pace of human development?

Answering these questions and designing the SNA Program to be as flexible and adaptable as possible is critical moving forward. This section of the strategy enumerates and discusses objectives, strategies, guiding principles and other considerations to maximize the SNA Program's success in achieving its mission.

Mission: The mission of the State Natural Areas Program is to locate, establish, and conserve a system of SNAs that as nearly as possible represents the wealth and variety of Wisconsin's native landscape for education, research and most importantly, to help secure the long-term protection of Wisconsin's biological diversity for future generations.

8. Objectives

8.1 Protect the Biodiversity of Wisconsin Encompassed Within Our Native Plant Communities, Including Rare Species, in an Era of Climate Change and Other Environmental Challenges

Strategy 8.1.1: Develop a weighted rating system using the following six guiding principles (see Section 9) to set priorities for SNA protection and management.

- Resilient and connected lands
- Ecological integrity
- Ecological representation
- Conservation opportunity areas
- Landscape-scale objectives
- Fragmentation and future development

Strategy 8.1.2: Evaluate the capacity of the SNA system to provide administrative support, land management and funding to facilitate protection of Wisconsin's biodiversity.

Strategy 8.1.3: Acquire, designate and legally dedicate SNAs using the principles identified in Strategy 8.1.

8.2 Protect Sites with Significant Geological and Archeological Features as Per State Statute 23.27

Strategy 8.2.1: Work with partners to identify and protect significant geological and archeological features.

8.3 Provide Stewardship for State Natural Areas Using the Principles of Ecosystem Management and Conservation Biology

Strategy 8.3.1: Use ecological integrity assessments to set site-specific management objectives.

Strategy 8.3.2: Combine climate change vulnerability assessments for natural communities with The Nature Conservancy's Resilient and Connected Lands spatial data to assess the vulnerability of each SNA.

Strategy 8.3.3: Use the Adaptation Workbook process to develop site-specific adaptation actions for SNAs with the highest conservation priority, as determined by Strategy 1, and low to moderate vulnerability.

Strategy 8.3.4: Assign a low management priority to those SNAs under severe native community conversion pressures and thus likely beyond the program's ability to retain in a desirable state.

Strategy 8.3.5: Use the existing Barrens, Grasslands, Savanna's, and Wetlands Rx priorities framework to prioritize management of fire-dependent plant communities on SNAs.

Strategy 8.3.6: Develop a refined prescribed fire prioritization at the appropriate scale for all state lands.

Strategy 8.3.7: Control invasive species classified as "prohibited" under the Invasive Species Rule (Chapter NR40, Wis. Admin. Code) on all SNAs, regardless of current site quality.

Strategy 8.3.8: Meet with partners to provide consistency across the SNA system regarding protection and management of all lands, regardless of ownership, and promote active, sustainable partnerships.

Strategy 8.3.9: Meet with DNR agency staff to assess management effectiveness and monitoring needs and develop alternatives for addressing those needs. Train field staff in best practices for conducting monitoring.

8.4 Identify and Accommodate Scientific Research

Strategy 8.4.1: Develop research priorities important to the long-term protection and management of the SNA system through a) priorities listed in the NHC taxon teams' 5-year strategies, b) priority conservation actions in the Wildlife Action Plan, or c) NHC research priorities included in DNR's biennial list of research priorities.

Strategy 8.4.2: Communicate with the research community to increase awareness of SNA properties as locations for conducting scientific research.

8.5 Provide Opportunities for Environmental Education

Strategy 8.5.1: Categorize SNAs (see #11 below) to identify sites appropriate for formal environmental education activities.

Strategy 8.5.2: Communicate with environmental education groups such as the Wisconsin Association for Environmental Education and the Wisconsin Center for Environmental Education, and educational institutions including universities, colleges and secondary schools, to increase awareness of the availability of appropriate SNAs as outdoor classrooms.

Strategy 8.5.3: Collaborate with the Natural Resources Foundation of Wisconsin and others to support and facilitate SNAs as locations for educational field trips and citizen-based science projects.

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Rock art or Geo photo

General Management photo

NRF Feildtrip photo

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9. Guiding Principles for Setting Strategic Conservation Priorities

Ensuring Wisconsin's SNA system remains effective conserving native biodiversity regionally and statewide requires a strategic approach, especially against a backdrop of significant and growing environmental challenges and limited program resources. To that end, six guiding principles (pg. 37, section 7.1.1) have been developed to guide the SNA Program's future direction and management. These guiding principles apply to priorities related to protection (i.e., site acquisition, designation and dedication) and management (i.e., site stewardship). Details for each principle are described below in order of relative importance.

9.1 Resilient and Connected Lands

As species, natural communities, and ecological processes are affected by climate change, areas previously identified as representative examples may be compromised, especially if they are highly vulnerable to direct or indirect impacts from climate change. The first guiding principle will focus conservation and management on lands naturally resilient due to

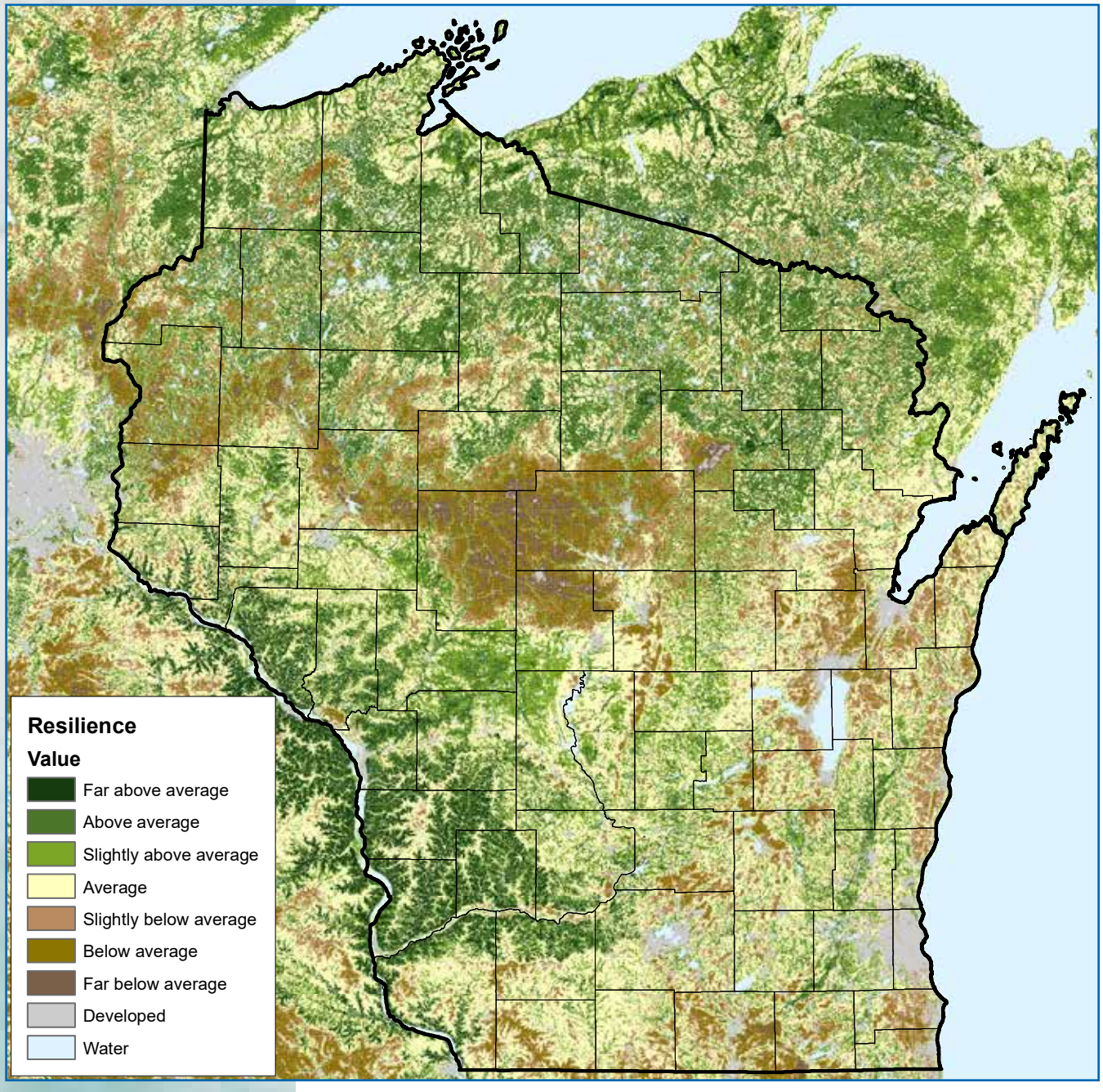
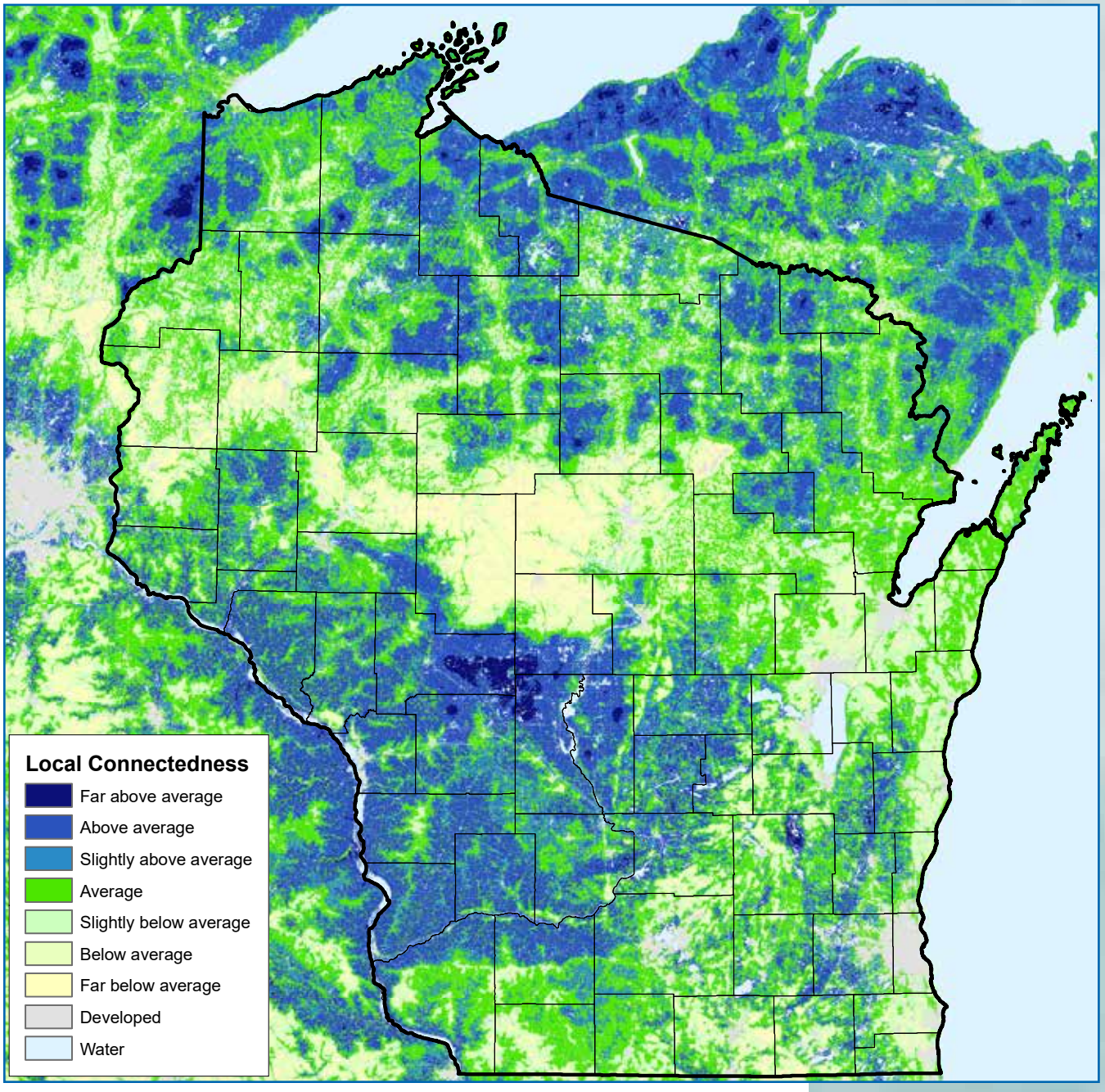


Figure 12a. Resilient lands in Wisconsin. Yellow areas are cells with an "average" estimated resilience score based on their landscape diversity and local connectedness compared to other areas with similar geology in the same NC ecoregion. Green areas score above average and are more resilient. Brown areas have below average scores and are expected to be less able to support biodiversity as climate changes. Data courtesy Anderson et al. 2018.

their diversity of geological, topographic and climate niches, and connected to other resilient patches (Lawler et al. 2015). This concept of using abiotic diversity as a coarse filter in the face of climate change is also sometimes referred to as Conserving Nature's Stage (Anderson and Ferree 2000, Beier et al. 2015).

Resilient sites can be defined as those more likely to maintain biological diversity and ecological function as the climate changes. These "***biodiversity strongholds***" have more variable topography and are more locally connected by natural land cover than other sites with similar soils/underlying bedrock (Lawler et al. 2015). This method of identifying resilient sites is also known as a geodiversity approach. Conservation is focused on conserving and managing the physical landscape over long periods of time rather than focusing on the particular species currently occupying the landscape (Anderson and Ferree 2010). Geodiversity and associated diverse climate niches also have been correlated with high rare species richness (Tukiainen et al. 2016) and are useful tools for conserving both rare and common species.

Figure 12b. Connected landscapes in Wisconsin. Connectedness is a function of existing land cover and different types of migration pathways that species are most likely to use as climate changes. "Diffuse flow" are areas with higher connectivity that offer numerous migration pathways. "Concentrated flow" are areas that offer important migration pathways through fragmented landscapes. "Constrained flow" are areas with limited but locally important pathways. Data courtesy Anderson et al. 2018.



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A network of resilient sites across all types of bedrock and soil in a region creates a blueprint for conserving ecosystems and species even as climate changes over time (Beier et al. 2015). Sustaining biological diversity and ecological processes across the region are more likely if the resilient sites are embedded in a larger network of connected lands that allow for dispersal and movement between sites (Anderson et al. 2018, Damschen et al. 2019). Products that integrate resilient and connected lands are especially useful tools for helping set protection and management priorities.

Connectedness is a function of existing land cover and different types of migration pathways that species are most likely to use as climate changes. "Diffuse flow" are areas with higher connectivity that offer numerous migration pathways. "Concentrated flow" are areas that offer important migration pathways through fragmented landscapes. "Constrained flow" are areas with limited but locally important pathways. Data courtesy Anderson et al. 2018.

Another tool for assessing the vulnerability of sites to climate change is the Climate Change Vulnerability Assessments for natural communities of Wisconsin (WICCI 2017). It is important to note that these assessments describe the degree of risk statewide and are based on generalized attributes of a given natural community. Any individual site may have characteristics that make it more or less vulnerable to climate change impacts. For site-level management, using structured decision-making frameworks can be extremely useful. For example, the U.S. Forest Service Northern Institute for Applied Climate Science's Adaptation Workbook can help evaluate site-level vulnerability and assess management risks and opportunities (Swanston et al. 2016)

Action: Assess the resiliency of SNAs by Ecological Landscapes using a Resilient and Connected Lands approach.

9.2 Ecological Integrity

Another guiding principle for setting conservation priorities will consider the current ecological integrity, defined as a function of site quality (vegetation structure, composition and lack of hydrologic or soil disturbance), landscape context and size. (See call-out box page 27). Ecological integrity is grounded in properly functioning reference sites but is not explicitly dependent on past conditions. In assessing the parameters, functional integrity is often given more weight than strict adherence to a historical snapshot, especially for vegetation structure and composition. Thus, individual species may enter or leave a community without affecting integrity provided they are not keystone species or ecologically invasive species. Periodic re-evaluation of ecological integrity parameters of the highest functioning sites could conceivably keep pace with changing environmental conditions over time.

While a suite of sites may help provide representation of a given community type across the landscape, it may be strategic and prudent to focus protection efforts on sites with higher ecological integrity, even if that means slightly less representation. Similarly, from a management standpoint, using ecological integrity rather than historical reference condition provides more realistic and attainable restoration goals. The concept of ecological integrity also underpins the categories of SNAs discussed in section 10, particularly the three subcategories of natural community SNAs: exceptional, representative, and compromised.

Action: Evaluate and update all natural community Element Occurrence ranks using ecological integrity assessment criteria within SNAs.

KMOO and or Chase Creek photo

9.3 Ecological Representation

For the SNA Program to fulfill its mission of conserving Wisconsin's biological diversity, natural communities are used as a coarse filter to protect the diversity of habitats in which species occur. The concept of ecological representation is still warranted and required by statute, and the SNA Program will continue to use a gap analysis approach to help set priorities for acquisition and designation. The spatial unit of representation will primarily be the 16 ecological landscapes, although finer spatial units also may be used to identify community variants based on Subsections or Land Type Associations from the National Hierarchical Framework of Ecological Units (Cleland et al. 1997).

Oak opening Algific slope

Each natural community type is distributed differently throughout the state, which contributes to the characteristics of each ecological landscape. Accordingly, opportunities to sustain these communities also vary by ecological landscape. These opportunities are scored in the Wisconsin Wildlife Action Plan using natural community-ecological landscape opportunity scores: high, medium, low and none. In ecological landscapes in which a given natural community is more common and extensive, there are higher conservation opportunities, and thus a greater number of representative examples will be sought. In ecological landscapes in which a given community is less common and extensive, fewer representative examples will be sought of these outliers.

Ecological representation also will reflect other guiding principles described in this section. It is strongly recommended that representative sites have at least average to above average climate resiliency and connectedness based on the Resilient and Connected Lands spatial dataset (Anderson et al. 2018), though there may be rare situations where this is unnecessary for conservation. Representation should also emphasize natural communities with high ecological integrity. Communities with low integrity likely will not provide good representation nor contribute significantly to long-term biodiversity conservation. While they may be of local importance, their conservation may be better accomplished through other programs or organizations. However, in cases of very rare communities where few examples with high integrity exist —e.g., oak opening, algific talus slope, etc. — inclusion of sites of lower integrity may be warranted, particularly where there is a commitment to improving integrity through management.

Ecological representation is largely based on natural community Element Occurrences, or EOs, captured in the NHI database. An EO is a population of a rare species or an example of a natural community occurring at a specific, ecologically appropriate location. A portion of the EOs in the NHI database have some limitations, however. For example, of the natural community element occurrences in the SNA system, 33% have not been formally evaluated since 1984, and 5% lack an indication of the integrity of the element occurrence. Natural community EOs occurring outside the SNA system have an even higher proportion of outdated information. In some cases, stressors such as invasive species or adjacent development have lowered the quality of some element occurrences to the point where they no longer meet thresholds of size or quality to be of conservation significance. To improve the ecological representation process, Natural Heritage element occurrences without integrity ranks and for which data are over 30 years old will be re-assessed and updated.

Action: Assess representation of high integrity natural communities within the current SNA portfolio and determine where representation is lacking in Ecological Landscapes with high to medium conservation opportunity scores.

9.4 Conservation Opportunity Areas

Conservation Opportunity Areas are places on the landscape containing ecological features, natural communities or species habitat for which Wisconsin has a unique or significant responsibility for protecting. These places are significant from a global, continental, upper Midwest, or state perspective (See Appendix 4). First identified in 2008 as part of the implementation plan for Wisconsin's Wildlife Action Plan, Conservation Opportunity Areas were identified as some of the best locations for effective implementation of conservation actions to conserve wildlife species of greatest conservation need (WDNR 2015a). While COA boundaries are typically updated during the 10-year wildlife action plan revision, they were not updated during the 2015 revision and yet are still useful, especially when used with other criteria to help prioritize SNA management, identification and protection. Moving forward, it would be valuable to update and refine the boundaries during the next Wisconsin Wildlife Action Plan revision in 2025.

Despite the need for refinement, the criteria originally used in identifying COAs align well with this strategy's guiding principles and can continue to serve a valuable role in conserving the state's native biodiversity.

Element Occurrence

A population of a rare species or an example of a natural community occurring at a specific, ecologically appropriate location.

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COA SN Grasslands

Northern WI is supposed to go with 9.6 but would feel kind of crowded over on page 37. Any other photos that could go here?

Or we can do just one tall grassland photo

Criteria for identifying Conservation Opportunity Areas include:

1. The presence of high priority Natural Community and/or Species of Greatest Conservation Need concentration.
2. Wisconsin's conservation responsibility to maintain ecological features significant to state, regional, continent, and globally significant populations and/or natural communities (WDNR 2015a). For example, pine barrens found in Wisconsin are considered a globally significant natural community due to their distinctive ecological characteristics, restricted range and range-wide rarity (See Appendix 4).
3. Areas or sites previously identified as a priority of conservation in other initiatives or plans. Examples include the Land Legacy Report, The Nature Conservancy's Ecoregional Plans, etc.
4. Areas or sites that establish an interconnected network or networks of conservation lands.
5. Large, minimally-fragmented, ecologically functioning systems.

Action: Update and revise COA spatial boundaries. Note: we believe this analysis is best completed through the WAP revision process rather than the SNA plan implementation.

9.5 Landscape-scale Projects: Scales of Conservation

During the SNA Program's formative years, the minimum viable size of a preserve was thought to be between one and two acres for prairies and 20 acres for forests (State Board for Preservation of Scientific Areas 1952). While established SNAs range in size from four acres to over 9,000 acres, the majority are under 500 acres.

Scientific research has since demonstrated that large conservation units – from thousands to tens of thousands of acres or more in size – are necessary for long-term conservation to be successful. Larger protected areas hold more species, provide critical habitat for wide-ranging or area sensitive species, and experience less loss of species than small protected areas (Alstad et al. 2016). While there will continue to be a role for small protected areas, moving forward the SNA Program will consider opportunities to scale-up conservation efforts. The appropriate scale for conservation depends on factors including species' needs, the size and condition of habitats, the degree of connectivity between habitats, the landscape context and socio-economic considerations. The Ecological Landscapes of Wisconsin (WDNR 2015b) should be consulted as this resource presents opportunities by ecological landscape in greater detail than the Wisconsin Wildlife Action Plan.

Because the SNA Program is not designed to acquire and protect entire landscapes, effective conservation of Wisconsin's biodiversity will be predicated on cooperatively managed landscapes. SNAs can play a critical role by serving as core protected areas within a landscape matrix managed for conservation. Such an approach will necessarily entail extensive collaboration with partners and stakeholders. A multi-partner effort to collaboratively restore and manage thousands of acres of pine and oak barrens in northwest Wisconsin is an example of an ongoing landscape scale partnership.

Action: Identify the best areas in the state for landscape-scale conservation that will contribute to the long-term conservation of native biodiversity.

9.6 Fragmentation and Future Development

When the DNR and partners consider conservation actions, particularly large-scale initiatives, threats posed by current and projected future development are an important consideration. For sites not within Conservation Opportunity Areas, ecological integrity assessment criteria may be used to assess existing fragmentation. For sites within COAs, Carter et al. (2014) analyzed the threat of development and proposed the following categories and potential priorities for conservation in Wisconsin (Figure 13). This information will be considered as the SNA Program and partners evaluate opportunities to coordinate protection, restoration and management efforts across large landscapes.

9.6.1 Conservation Strongholds

Areas where landscape-level connectivity exists because a large percentage of land is already protected, and thus future housing development pressure is low. Mainly applies to select areas in northern Wisconsin.

9.6.2 Narrow Opportunities for Conservation

Areas with low levels of protected lands in a landscape, subdivided and fragmented by relatively high housing densities and further threatened by future development. Land prices are high, land management is complex and costly, and existing undeveloped lands between protected parcels is likely to be developed in the near future.

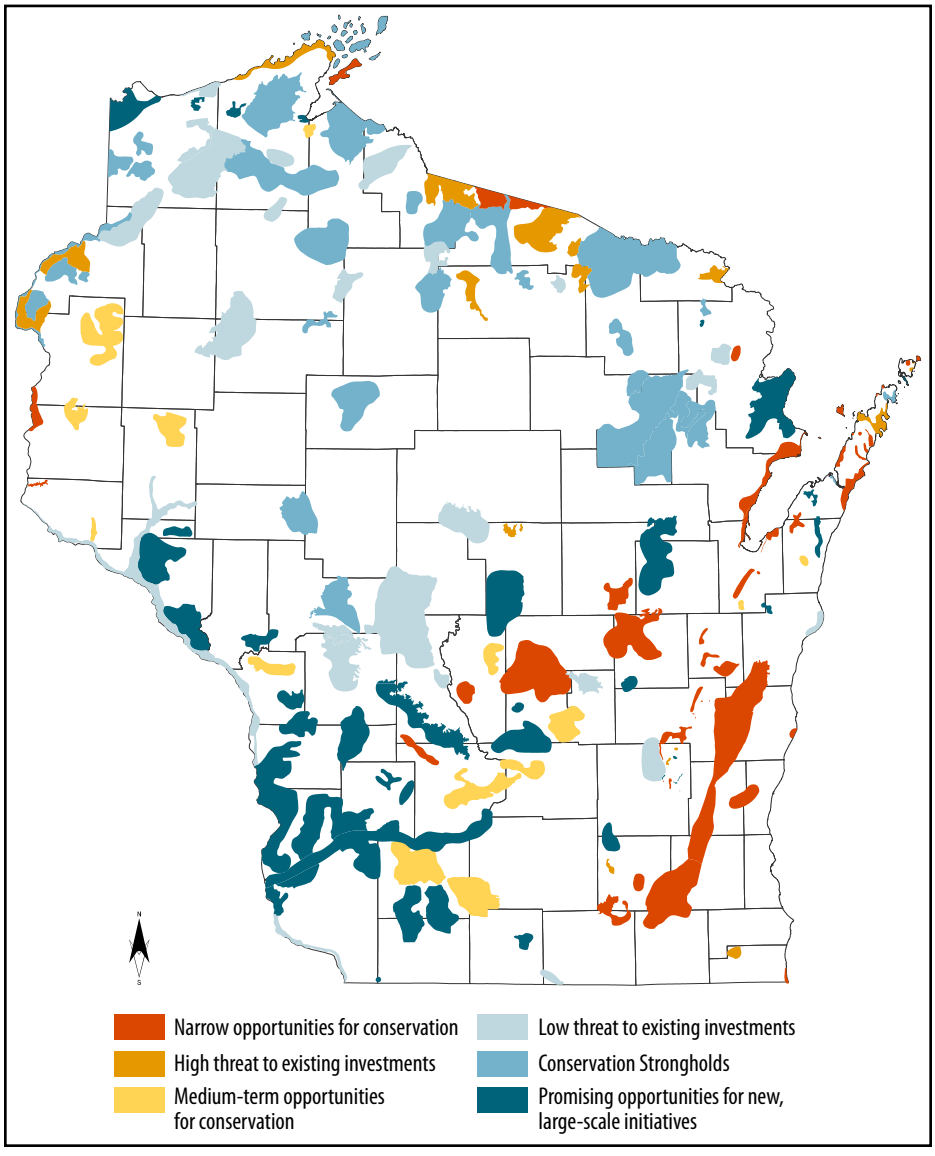

Figure 13. Categories of priority areas in the Wisconsin Wildlife Action Plan. Reprinted from Carter et al. 2014 with permission from Elsevier.

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9.6.3 High Threat to Existing Investments

Areas where significant resources have been invested in land protection, existing land management costs are likely substantial, and existing undeveloped lands between protected lands are likely to be developed by 2030.

9.6.4 Medium-term Opportunities for Conservation

Areas where there is a low percentage of protected land and a medium threat of future development. A substantial amount of conservation 'flexibility' still exists on the landscape, and prices are likely to be moderate. Housing pressure and land prices will increase substantially, and existing undeveloped lands between protected areas are reasonably likely to develop by 2030.

9.6.5 Low Threat to Existing Investments

Areas with a moderate percentage of existing protected land and a low threat of future development. Substantial resources have already been invested but land protection goals may not have been reached. The threat from current and future housing development is low in these working landscapes.

9.6.6 Promising Opportunities for New, Large-scale Initiatives

Areas with a low percentage of existing protected land and a low threat of future development. Relatively little land has been protected, ample flexibility exists on the landscape and land prices and development pressure are low and projected to remain low until at least 2030. Habitat fragmentation is generally not a concern except possibly for area-sensitive species.

Action: Apply fragmentation and future development risk analysis in the evaluation of the current SNA portfolio and large-scale conservation opportunities.

10. SNA Management in Light of Environmental Challenges and Guiding Principles

The environmental stressors described in Section 6 pose challenges to effective long-term management of the SNA system. Moving forward, the SNA Program will apply relevant Guiding Principles within an adaptive management framework. (Figure 14).

It is expected that fundamental tools and techniques used to manage the SNA system will be consistent throughout the duration of this strategy. However, the timing, intensity, and extent of management efforts are likely to change in response to environmental stressors and established conservation targets.

Adaptive Management Wheel

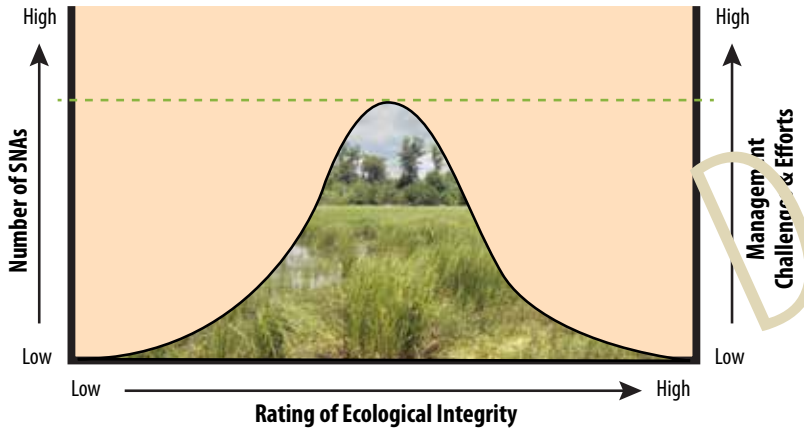
Figure 14. The Adaptive Management Cycle illustrates the iterative process for making conservation decisions and taking actions in the face of uncertainty. Goals and strategies are developed and implemented on the ground via management actions. Uncertainty is addressed through monitoring and subsequent evaluation of the implementation, leading to adapting and improving future goals, strategies and management actions.

10.1 Ecological Integrity

State natural areas are distributed along a gradient of low to high ecological integrity, and management approaches vary in relation to where a site falls along that gradient (Figure 15). For sites expected to maintain high ecological integrity over time, management will focus on invasive species control and sustaining ecological processes, such as the historical disturbance regimes that shaped the communities and the associated landscape. Sites with low ecological integrity are typically degraded or compromised to the point where intensive management is no longer justified. This shift in management priorities will allow managers the flexibility needed to navigate the many challenges facing the SNA program.

10.2 Climate Change

Management options to respond to climate change vary along a spectrum from resisting change to accommodating change to directing change (Fisichelli et al. 2016). The degree of management effort needed also will vary along that gradient. On sites where a decision is made to resist change, management intensity and effort may increase. Some systems may naturally resist change due to their geology and ecology — bluff prairies and dry cliffs— especially where anticipated effects of climate change like warmer temperatures and decreased soil moisture may help sustain the community. Management effort may be high on sites targeted for transformation, although this largely depends on the degree of effort



Ecological Integrity and Management Efforts

Figure 15. Conceptual relationship between ecological integrity and management effort. Management challenges and effort are expected to be lower for sites with low or higher ecological integrity than for SNAs with intermediate ecological integrity.

needed to direct change at the site. Management effort will likely be lowest when the goal is simply to accommodate change, that is, to allow changes to occur without significant management intervention.

Climate change may alter the timing of when SNA crews are able to conduct management activities, increasing the difficulty of conducting prescribed burning or timber harvests. Spring prescribed burning windows may, for example, become prohibitively short, causing a shift to late-summer and fall burns. This may, in turn, lead to conflicts with rare herptiles, plants, invertebrates and other non-game species that may be nesting or otherwise biologically active at that time and thus vulnerable to negative impacts from fire. Available guidance measures, such as the *Broad Incidental Take Permit/Authorization for Grassland and Savanna Management* (WDNR 2019) will be used to guide management decisions to limit adverse impacts to rare species.

10.3 Natural Community Conversion

Suppression of wildfire, cessation of fires set by Native Americans, and lack of active management have caused historically open canopy community types like oak savanna to succeed to shrubs and shade-tolerant trees, significantly reducing the abundance and distribution of shade-intolerant species. As conversion advances, ecological integrity decreases, making the site progressively more difficult to restore. Given limited resources, sites with low ecological integrity will likely become too costly for restoration while sites with high ecological integrity will be prioritized for resource allocation and active management.

Climate vulnerability assessments suggest that the climate may eventually become more supportive for some natural communities currently facing conversion pressures, such as oak barrens and southern dry-mesic forest (WICCI 2017). These communities are currently experiencing high rates of invasion by shrubs and shade-tolerant tree species ("mesophication"; Nowacki and Abrams 2008) but a warmer, drier climate may reduce these pressures and instead favor oaks over the long term. Thus, resources will continue to be directed to SNAs with these communities to ensure their viability until the climate is more favorable to their persistence (Nowacki and Abrams 2015).

10.4 Invasive Species

The most cost-effective means of addressing invasive species is preventing their introduction and spread. This is particularly true in northern Wisconsin, where the number and abundance of invasive species is lower than in southern Wisconsin. Regardless of location, when resources for effective control of invasive species are lacking, containment should be considered a secondary strategy. All management actions should follow Best Management Practices related to non-native invasive species to avoid further spread. Invasive species listed as prohibited and restricted under Wisconsin's invasive species law, Chapter NR 40 of the Wisconsin Administrative Code, will continue to guide management priorities as well as early detection and rapid response strategies.

Fire Timing photo

OBT bees Karner

Dry Cliff

Bluff prairie

Naturally resistant Nas photos

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11. SNA Categorization

The State Natural Area system's 691 sites represent a significant workload for program administration and land management. Although most SNAs are equivalent from an administrative and policy perspective, they differ, sometimes significantly, in protection and management needs. It is impractical and ineffective to treat all SNAs equally. As authorized by statute, SNA Program staff will categorize SNAs to help administer policy, prioritize land management, manage public use and steer needed resources to SNAs of the highest priority. The following categorization system also will allow SNAs to be grouped by similarity and provide program staff a more efficient way to evaluate public use requests.

As previously noted, a goal of the SNA program, as directed by state statute, is to maintain ecological "reference areas" used for comparison with other managed lands where biodiversity protection is not the primary objective. In the past, only a subset of SNAs were considered ecological reference areas. Going forward and to meet statutory intent, all SNAs will serve as reference areas in their respective categories except for those in the critical species category.

Categories

11.1 Natural Community SNA

The primary target for conservation for sites placed in this category are terrestrial and wetland ecological communities, along with associated populations of rare plants and animals found therein. SNAs containing strictly aquatic community features as their primary targets of conservation are not included in this group. Natural Community SNAs are further categorized as Exceptional, Representative, and Compromised based on the overall quality of their natural features, as described below.

a) Exceptional

State natural areas in this category are the very best sites and exemplify the SNA Program's mission and goals. The natural communities identified as the primary focus of conservation maintain high (A or B) Element Occurrence Ranks and reflect above average metrics for ecological integrity. Generally, exceptional sites also tend to have above average characteristics of resilience. The DNR will dedicate available resources to ensure long-term protection and viability of these sites.

b) Representative

Natural communities in this category constitute the majority of SNAs in the system. They will have an intermediate Element Occurrence Rank (lower than B), with average metrics for overall ecological integrity. Many are the best examples of a given community type in an ecological landscape. Resources allocated to manage and protect these sites will be subject to program prioritization. Generally, representative sites tend to have average characteristics of resilience. This category can also include moderately degraded sites still a priority for maintaining native biodiversity through restoration and management.

c) Compromised

State natural areas placed in this category contain natural communities that no longer meet the SNA Program mission due to a significant loss of ecological integrity. Communities exhibit low Element Occurrence Ranks (generally C or lower), with poor metrics for ecological integrity. Ecological degradation of these sites has been determined to be irreparable and restoration impractical. Generally, compromised sites also tend to have below average characteristics of resilience. Further investment of resources for site management and protection should be curtailed or eliminated. State natural areas in this category will be evaluated for potential withdrawal from the SNA system.

11.2 Aquatic SNA

The primary focus of conservation prompting inclusion in this category is high-quality, strictly aquatic natural communities -- including unique lake types and stream reaches -- or sites that offer exceptional opportunities for research. Although SNAs placed in this category likely have terrestrial or wetland communities associated with them, protection and management resources are directed primarily toward their aquatic features.

Exeptional Nat Comm photo

11.3 Critical Species SNA

Many SNAs provide habitat for Endangered, Threatened, and Special Concern plants and animals. However, Critical Species SNAs are typically designated for the protection of one or more populations of a rare species of statewide significance. These sites may or may not have natural communities of high ecological value. This category includes not only sites protecting individual species populations but also rare species concentrations including mussel beds, bat and herptile hibernacula and rookeries.

11.4 Geological SNA

State natural areas in this category specifically recognize and protect exemplary or unique geological or hydrogeologic features, including outstanding bedrock exposures, glacial and other landforms, fossil sites, caves and springs. Although these SNAs may contain ecological communities or rare species, they are not primary considerations for management or protection purposes.

11.5 Archeological SNA

The primary conservation target for SNAs in this group is protection of exceptional archeological features such as Native American rock art, effigy and burial mounds and habitation sites. Although these SNAs may contain ecological communities, they are not the primary consideration for management or protection purposes.

12. Coordination with SNA Partners

No single organization has the capacity needed to conserve Wisconsin's biodiversity alone. The statewide distribution of the SNA system, 60+ different owners (Appendix 7), and rapidly emerging environmental challenges necessitate a cooperative approach to protect Wisconsin's native plant and animal communities. Durable conservation can be achieved only through establishing dynamic partnerships that leverage resources, drive innovation and generate local support. Existing partners are essential for the adaptive evolution and long-term viability of the SNA system.

From a management perspective, the diversity of SNA ownership creates potential for divergent views on long-term natural community management goals. Given variability in property size and available resources, management approaches can and should vary across ownership, but consistency in adhering to system-wide conservation goals is needed for statewide program success.

13. Measuring Success

Metrics are critical to the implementation of any adaptive habitat conservation program. They allow the SNA Program to evaluate the success of decisions and management actions in achieving program goals. Monitoring and research are the two basic components of measuring success.

13.1 Monitoring

All sites in the SNA system have had various levels of inventory of flora, fauna and natural communities, but there is no comprehensive program to monitor change over time. State natural areas have been included as a part of larger statewide or regional monitoring projects targeting selected taxa such as bats, breeding birds, amphibians, small mammals, insect groups and rare plants, but SNAs have generally not been the primary focus of these larger studies. In the early 1990s, a project to collect baseline vegetation data on a subset of grassland and forested SNAs was initiated but the data were never analyzed and no subsequent site-level monitoring was done.

There is a need for an adaptive SNA monitoring strategy to measure the effectiveness of management activities and adjust goals and associated conservation strategies as needed. Development of such a strategy will be part of the implementation planning effort.

Karner Blue meadow

Bat cave

Geo SNA photo

Arch SNA photo

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pic of survey/ monitoring work

peatland

wetland monitoring work

Four Categories of Monitoring

For SNA Program purposes, monitoring can be broken down into four broad categories covering the kind of monitoring and the responsible staff or organizations.

13.1.1 Management Effectiveness Monitoring

Monitoring the effectiveness of management actions is generally site-based but also can be used across many sites. Developing specific management objectives and targeting monitoring methods to evaluate current site conditions are crucial for efficient monitoring to determine if actions are helping meet management goals. Role of SNA Program: Central office and field staff should conduct basic monitoring to evaluate the effectiveness of management actions.

13.1.2 Rare Species Monitoring

This category applies to the health or "status" of rare species occurring on SNAs but not the primary target of management activities. Where rare species are linked directly to management goals, monitoring also may involve effectiveness monitoring described above.

Role of SNA program: Central office and field staff provide information and assist with some surveys on sites but generally do not lead efforts to conduct extensive monitoring of rare species. Species experts in the Bureau of NHC, outside academic institutions and volunteers through citizen-based monitoring efforts conduct most rare species monitoring.

13.1.3 Obligatory Monitoring

Some monitoring is required by manual code or other obligations such as implementing master plans, monitoring High Conservation Value areas and Representative Sample Areas for forest certification, or monitoring to fulfill stipulations outlined in a grant. Site inspections are a form of obligatory monitoring. DNR Manual Code 1751.1 stipulates that DNR-owned SNAs be inspected and documented annually unless dictated otherwise in a management plan. See Appendix 5).

Role of SNA program: SNA site inspections are normally completed by the SNA's designated property manager or local field staff. State natural areas owned by program partners are inspected by them on their own schedules. Site inspections document the ecological health and land management issues of an SNA, including needs for invasive species control, prescribed fire and community restoration. Public use issues and the condition of SNA facilities — signs, fences, parking lots, trails, etc.— are also recorded. Other obligatory monitoring is done on an as-needed basis.

13.1.4 Environmental Challenges Monitoring

This category refers to monitoring that seeks to answer big-picture questions regarding the extent, severity or impact of previously identified environmental stressors. It does not apply to situations where stressors are directly tied to management activities at a SNA.

Role of SNA program: In general, the SNA Program does not conduct broad-scale monitoring of environmental stressors, though staff welcome cooperative efforts to assess stressors' impact and to monitor broad-scale approaches to address these challenges. Where environmental stressors are a specific concern, program staff may conduct monitoring to address specific questions like investigating the impacts of decreasing thickness and duration of snowpack on Karner Blue butterfly overwinter survival at Karner Blue Meadows State Natural Area, or the impact of deer browse on hemlock regeneration at Van Vliet Hemlocks State Natural Area.

For each of the four monitoring categories it is imperative to apply the adaptive management wheel concept shown in Figure 14 when designing monitoring strategies and to have scientifically-sound protocols.

13.2 Monitoring on State-owned Versus Partner-owned State Natural Areas

NHC will work with partners to align monitoring approaches between partner SNAs and DNR-owned sites to advance the program mission.

13.3 Research

Research is a fundamental part of the SNA Program mission. An important need for research is to help answer questions related program management and implementation that cannot be answered by monitoring alone. Research on DNR-owned sites is encouraged and welcomed, especially study advancing the SNA Program mission. SNA Program staff do not currently conduct original research, but SNAs are sometimes included as study sites for DNR research originating from other bureaus. The SNA Program's parent bureau, Natural Heritage Conservation, submits research priorities, including for SNA-related research, to the DNR Office of Applied Science through a biennial process that determines which DNR research projects are funded and conducted. Internally, NHC taxon teams also identify research needs every five years for their respective taxa groups including birds, mammals, plants and natural communities. SNA Program staff work collaboratively with the taxon teams regarding research needs and priorities for SNAs. In addition, contingent on available resources, NHC will consider cooperating with universities and other research entities to implement high-priority SNA research included in taxon team five-year strategies.

14. Conclusions and Next Steps

Completion of the SNA Strategy will provide a unifying framework for consistently administering and managing all aspects of the SNA Program when considering existing and anticipated environmental challenges. The strategy establishes programmatic sideboards for maintaining the persistence and viability of Wisconsin's State Natural Areas program moving forward yet recognizes the dynamic nature of a rapidly changing world by maintaining a requisite level of flexibility.

The SNA Program faces environmental challenges that are increasing in number, extent and intensity, and therefore require re-thinking and refine SNA protection and management approaches over the next 10 years. Given that these challenges limit the ability to manage SNAs with the target of maintaining pre-settlement natural communities, these historical reference conditions will henceforth be considered as ***waypoints*** or interim targets rather than as restoration ***endpoints***. To that end, the plan identifies six guiding principles to be considered for establishing goals and priorities that go beyond the paradigm of relying solely on representation of pre-settlement plant communities. The SNA Program will strive to consistently apply these principles to direct an adaptive management approach to address environmental challenges and to enable strategic planning and implementation of management activities to maximize use of limited resources and enhance return on conservation investments.

The strategy also recognizes the need for metrics to evaluate the success of decisions and actions in implementing conservation and management. Monitoring and research are two important components for measuring success and allow for iterative learning and adjustments to conservation goals, design and management actions over the lifespan of this strategy.

Finally, completion of this document sets the stage for development of an ***implementation plan*** incorporating the strategies identified in this document. That plan will establish action items for each strategy and their implementation will contribute to the long-term protection of Wisconsin's native biodiversity.

For more detailed information regarding the plans and resources used in the development of this document, please refer to Appendix 6.

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Glossary

Adaptive management – A dynamic process in which current and future conservation decision making is modified based on observations and a desire to improve outcomes. In this process, resource practices change based on learned experiences over time.

Altered Natural Disturbance Regimes – A change in patterns of frequency, timing, duration and spatial extent of natural ecological processes such as fire, flooding, insect outbreaks and wind events that affect the development and maintenance of ecosystems and landscapes in a particular area.

Conservation Opportunity Areas – Places on the landscape that contain significant ecological features, natural communities or Species of Greatest Conservation Need habitat for which Wisconsin has a responsibility for protecting when viewed from a global, continental, upper Midwest regional or statewide perspective (WDNR 2015a).

Ecological Integrity – A means of evaluating plant communities, building on related concepts of biological integrity and ecological health. Ecological integrity is defined as "the structure, composition, and function of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historic disturbance regimes" (Parrish et al. 2003, Faber-Langendoen et al. 2016).

Ecological Landscapes – Adapted from *Ecological Landscapes of Wisconsin* Defined geographical units that share similar geology, soils, vegetation and management opportunities and are based on the National Hierarchical Framework of Ecological Units (Cleland et al. 1997). Wisconsin is divided into 16 recognized ecological landscapes (WDNR 2015b).

Ecological Reference Area – A community of organisms able to act as a model or benchmark for restoration. Ecological reference areas usually include remnant natural areas which have not been degraded by human activities such as agriculture, logging, development, fire suppression, or non-native species invasion. Reference ecosystems are ideally complete with natural flora, fauna, abiotic elements, and ecological functions, processes, and successional states (McDonald et al. 2016).

Ecological Representation – The concept of protecting and managing representative examples of high-quality natural communities across the state in the ecological landscapes where they historically occurred.

Fire-dependent (or fire-adapted) Plant Communities – Vegetation types historically formed and maintained by periodic fires of a particular frequency, intensity and seasonality. The dominant vegetation of these systems is adapted to and thrives after fire.

Gap Analysis – A tool used in wildlife conservation to identify gaps in conservation lands (e.g., protected areas and nature reserves) or other wildlands where significant plant and animal species and their habitat or important ecological features occur (Scott and Schipper 2006).

Geodiversity – The natural diversity of rocks, minerals and fossils, landforms, topography and physical processes, soil and hydrological features. This concept includes their assemblages, structures, systems and contributions to landscapes (Gray 2013). Geodiversity is correlated with biodiversity and is often combined with climate niche modeling to identify biodiverse areas naturally resilient to climate change.

Historical Reference Condition –The assumption that the species and ecological processes that characterized ecosystems in the past will be appropriate for the future. Historical reference conditions are usually derived from the centuries immediately before Euro–American settlement and are often used to determine desired future conditions to guide land management (Safford et al 2012).

Mesophication – The escalation of mesic microenvironmental conditions, accompanied by ever-diminishing prospects for fire and fire-dependent species. By altering environmental conditions, shade-tolerant species deter fire through dense shading that promotes moist, cool microclimates and the production of fuels that are not conducive to burning. This phenomenon is reinforced and amplified by feedback loops, whereby conditions continually improve for shade-tolerant mesophytic species and further deteriorate for shade-intolerant, fire-adapted species (Nowacki and Abrams 2008).

Natural Community – An assemblage of different plant and animal species living together in a particular area at a particular time in a specific habitat. Communities may be named for their dominant plant species, for example, pine barrens, sedge meadows and oak savannas, a prominent environmental feature, such as Great Lakes dune, dry cliff, or some combination of these factors.

Non-stationarity – Recognition that the environmental conditions and ecological processes that lead to the development of natural communities are not constant but changing over time, especially under climate change and other largescale environmental changes.

Pre-settlement Natural Community – The structure and composition of vegetation types in Wisconsin before intensive European settlement during the mid-1800s.

Regionally Native Biodiversity – Refers to species occurring naturally in a given geographic area such as the Upper Midwest. These species have evolved in that geographic area as opposed to having been transported there by people from other regions or continents.

Resilience – The capacity of an ecosystem to absorb disturbance and respond to those perturbations and still retain essentially the same structure, function and identity (Walker et al. 2004).

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State Natural Area Strategy Appendices

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Appendix 1. State Statutes and Administrative Codes

- *Chapter 23.26 Wis. Stats. legislatively authorizes the Natural Areas Preservation Council. Stipulates council duties.*
- *Chapter NR 15.347 Admin. Code codifies the Natural Areas Preservation Council.*
  - *Stipulates council appointing entities.*
- *Chapter NR 1.32 Admin. Code confirms the Natural Resources Board's validation and support of the legislature's intent to establish and protect natural areas.*
  - *Confirms the DNR's charge to conduct natural areas inventories, recommend natural areas to the NRB for acquisition and designation, manage natural areas, and encourage research and educational use of natural areas.*
- *Chapter 23.27 Wis. Stats. provides broad program authority.*
  - *Defines natural areas and states importance of natural area protection.*
  - *Authorizes the Natural Heritage Inventory Program*
  - *States intent to expend funds for land acquisition.*
- *Chapter 23.28 Wis. Stats. provides authority to designate natural areas.*
  - *Authorizes SNA establishment and Research Natural Area classification.*
  - *Charges DNR with stewardship and protection.*
- *Chapter 23.29 Wis. Stats. provides authority to legally protect natural areas.*
  - *Authorizes legal dedication and stipulates DNR's responsibilities for dedicated SNAs.*
  - *States procedures for dedication and removal of dedication.*
- *Chapter NR 40 Admin. Code is the Invasive Species Identification, Classification and Control rule.*
- *Chapter NR 45 Admin. Code governs the public use of state lands and provides for the protection of natural resources.*
  - *Chapter NR 45.13 Admin. Code codifies property rules specific to SNAs, including rules applicable to all SNAs as well as individual property restrictions.*

Appendix 2. State Natural Area Withdrawal Report

SNA Name: _____

SNA Number: _____ **SNA Webpage URL:** _____

Designation Date: _____

Owner/Land Control: _____

Property Manager/Field Ecologist: _____

Report Author: _____ **Date of Report:** _____

Date of Final Withdrawal: _____

1. **Document why this site no longer meets standards for SNA designation, is not ecologically defensible as an SNA, and should be withdrawn from the SNA system.**
   a. Review and defend the current Element Occurrence ranks of the primary natural communities (or features) for which the SNA was initially established and explain how they have changed since designation.
      i. *Consider the defensibility, viability and quality of the site.*
      ii. *Include extant and anticipated threats (both human-caused and natural) that have led to site degradation. Explain why the degradation is irreparable and why remediation is impractical.*
      iii. *Indicate the date of the most recent site inspection.*
   b. Confirm that withdrawal of the site from the SNA system is warranted irrespective of the amount of resources previously expended to manage it.
2. **Discuss the former statewide significance of the features protected at this site and why their preservation as a designated SNA is no longer vital to the priorities and mission of the SNA Program.**
   a. Consider the rarity and statewide/regional importance of the features and the degree to which Wisconsin is responsible for ensuring their regional/global preservation.
   b. Indicate if the features of this SNA fill a protection "gap" in its respective geographic area and discuss the degree to which higher quality examples of these features are adequately protected in other SNAs. Name examples.
   c. List other sites, if any, in the same geographic area that could potentially be designated as SNA to protect similar features.
3. **Describe any other protection tools or laws currently in place or that could be applied to the site in lieu of SNA designation (such as conservation easement, deed restriction, zoning, critical species habitat designation, Endangered Species Act, etc.).**
4. **Notwithstanding the current ecological quality of the SNA, discuss the current and potential value of this property for other public uses, including recreation, education and research.**
   a. Include the SNA's value to serve as an area to study impacts resulting from disturbance and ecological decline. Describe how withdrawal might affect such activities.
5. **Briefly describe the intended land management for the SNA after removing designation.**
   a. Consider management for rare species.
6. **For SNAs owned by program partners, discuss any anticipated concerns that the partner may have if the site were withdrawn from the SNA system.**
7. **Identify resources consulted during the preparation of this withdrawal report. Confirm that affected parties agree with the withdrawal proposal, or if not, why not.**
8. **Describe the degree to which withdrawal of this SNA may not be supported administratively, publicly and/or politically.**
9. **Describe any additional concerns or consequences of this withdrawal proposal.**

☐ Based on the justification provided in this document as report author, I hereby confirm the recommendation that this site be formally withdrawn from the State Natural Area system.

Attach to this report:
Any information that corroborates the proposal to withdraw this SNA. Include such items as site inspection reports, public notice comments, site photographs, air photos, maps, etc.

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Appendix 3. State Natural Area Withdrawal Process

Sites proposed for withdrawal will be evaluated using an extensive analysis requiring documentation of the reasons why the SNA no longer meets the standards for designation, and an explanation of why degradation of the site is irreparable and restoration impractical. Withdrawal proposals will be vetted following a new process requiring consultation with the SNA Program and approval of the NHC Management Team, the Natural Areas Preservation Council, and the DNR Natural Resources Board.

The process outlined below defines the sequence of steps and the responsible parties in brackets after each step. This process should be considered for codification in Manual Code.

Abbreviations for responsible parties:

SNA CO = State Natural Area Program Central Office Staff
NHCMT = Bureau of Natural Heritage Conservation Management Team
FE = Natural Heritage Conservation Field Ecologist
NAPC = Natural Areas Preservation Council
NRB = Natural Resources Board

DNR-owned State Natural Areas:

1. **Prepares SNA Withdrawal Report [SNA Central Office, Field Ecologist, or Property Manager].**
    a. Consults with property manager, field ecologist, land control bureau, experts, and others as needed to complete withdrawal report.
    b. Forwards to SNA CO.
2. **Reviews withdrawal proposal [SNA CO].**
    a. Confirms accuracy of withdrawal report.
    b. Conducts field inspection, if necessary.
    c. Consults with land control bureau, FE, property manager.
    d. Recommends to accept, reject or modify withdrawal proposal.
    e. Forwards to and briefs Bureau of Natural Heritage Conservation management team for concurrence.
3. **Approves or rejects withdrawal proposal [NHCMT]**
    a. Consults with land control bureau administration to reach and confirm decision.
    b. Informs SNA CO, FE, initiator, and other interested parties of decision.
    c. Informs NAPC.
    d. If approved, determines need for NRB approval/notification per Ch. NR1.32 or master planning rules.
4. **Initiates public notification process as necessary [SNA CO]**
    a. Determines need for public notice of withdrawal.
    b. Publishes notice, collects comments, summarizes input and amends proposal if warranted.
5. **Approves or rejects withdrawal proposal [NRB]**
6. **Removes SNA from SNA system [SNA CO]**
    a. Removes SNA from web, mapping applications, etc.
    b. Retains paper file and record of withdrawal decision.
    c. Informs interested parties.

Appendix 3. State Natural Area Withdrawal Process *(continued)*

Partner-owned state natural areas:

1. **Prepares SNA Withdrawal Report [SNA CO, Field Ecologist, or Partner].**
    a. Consults with partner, property manager, FE, experts, etc. to complete withdrawal report.
    b. Forwards to SNA CO.
2. **Reviews withdrawal proposal [SNA CO]**
    a. Confirms accuracy of withdrawal report.
    b. Conducts field inspection, if necessary.
    c. Consults with partner and FE.
    d. Ensures consistent application of decision-making criteria.
    e. Recommends to accept, reject, or modify withdrawal proposal.
    i. If rejected, attempt to renegotiate designation Memorandum of Understanding with partner to retain SNA.
    f. Forwards to and briefs NHCMT for concurrence.
3. **Approves or rejects withdrawal proposal [NHCMT]**
    a. Consults with partner as needed to confirm decision.
    b. Informs SNA CO, FE, initiator, etc. of decision.
    c. Informs NAPC.
4. **Removes SNA from SNA system [SNA CO]**
    a. Sends formal notification to partner to terminate MOU.
    b. Removes SNA from web, mapping applications, etc.
    c. Retains paper files and record of withdrawal decision.
    d. Informs interested parties.

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Appendix 4. Wisconsin's Conservation Responsibility

Excerpted from Wisconsin Wildlife Action Plan (2005-2015). Implementation: Priority Conservation Actions and Conservation Opportunity Areas (DNR 2008)

Significant Ecological Features for Wisconsin

The ecological features described here are those for which Wisconsin has an opportunity and responsibility in helping maintain regionally, continentally, and globally significant populations and/or natural communities. This information, along with maps identifying locations in Wisconsin where these features occur, was used to help set priorities for the State Wildlife Action Plan.

Globally important resources in Wisconsin

Great Lakes and Their Shorelines

The Great Lakes are the largest freshwater lakes in the world and their shorelines support a diverse and distinct mosaic of natural communities and many regional endemic species. Lake Superior has important fisheries and bird habitat supporting lake trout and whitefish spawning and nesting piping plovers. Lakes Superior and Michigan and their shorelines are important migratory bird corridors and provide habitat for wintering waterfowl. The Apostle Islands have exceptional examples of old-growth forests, beach and dune complexes, coastal wetlands and bedrock features. There is a tremendous regional repository of rare biota and intact natural communities here. The freshwater estuaries on the southwest shore of Lake Superior are in relatively good condition —some are "pristine"— and unique. Many other Great Lakes estuaries, especially east of Wisconsin on the "lower" lakes, are degraded due to poor water quality, development and serious infestations of invasive species. Ridge and swale complexes are unique features of the Great Lakes shorelines, contain diverse assemblages of natural communities, and are especially prominent along Lake Michigan. The lake plain prairie complex on southwestern Lake Michigan is the only non-forested ridge and swale system in the state and includes Chiwaukee Prairie. "Sandscapes," which include sandspits, coastal barrier spits, cuspate forelands and tombolos, protect a diverse array of important natural communities and provide critical habitat for rare species including piping plover. Major concentrations of migratory birds occur on some of these sandscapes, especially the coastal barrier spits such as Long Island and Wisconsin Point. The Door Peninsula and Grand Traverse Islands have high concentrations of rare species associated with the calcareous soils and exposures of dolomite that characterize shoreline environments. Some "maritime" forests on the mainland and on offshore islands are of high quality.

Northern Highland Kettle Lakes and Pine Forest

This sandy outwash plain has one of the highest densities of glacial kettle lakes in the world. It is a complex heterogeneous landscape of forested uplands, diverse wetlands and many lake types. Some lake types, unmanipulated spring ponds and undeveloped connecting streams, are now quite rare. Some rare lake types feature clear water, hard bottoms, exceptionally low nutrient levels, and support rare invertebrates and fish species that are far better represented in this landscape than anywhere else in the state. Some lakes and low gradient streams support wild rice beds, which are important ecologically and culturally.

The pine-dominated dry-mesic forests occurring here are different than the matrix of hemlock-hardwood forest that historically covered most of northern Wisconsin and surrounds this landscape. This is the best place in Wisconsin to practice large-scale white pine/red pine forest management, with opportunities to represent all age classes and patch sizes, including those which are currently scarce or absent. Natural red pine forest is at the center of its continental range here, which is limited to the northern Lake States, Ontario, and the Appalachian Mountains. Wildlife species associated with coniferous forests are especially well-represented here.

Pine-oak Barrens

Pine barrens found in Wisconsin are globally significant due to their distinctive ecological characteristics, restricted range and range-wide rarity. Their species composition differs from the New Jersey pine barrens, which are pitch pine-dominated and well east of the range of many prairie species so important in the Upper Midwestern barrens. Elsewhere in the Upper Midwest, pine barrens are degraded or the remnants small, offering limited opportunities for restoration or management. Wisconsin pine barrens support a high number of rare species including some that are globally rare such as the federally endangered Karner blue butterfly and the Kirtland's warbler, and many on the state list of Species of Greatest Conservation Need. Pine barrens in Wisconsin are dynamic and highly variable fire-driven ecosystems and can be managed for a continuum of natural structurally distinct community types from semi-open brush prairie, to savannas with scattered trees, to closed canopy dry forest.

Appendix 4. Wisconsin's Conservation Responsibility (*continued*)

Bur Oak Openings

The Great Plains has savanna communities all along its eastern edge, but those farther south and west are much different than those in Wisconsin. The Nature Conservancy called the savanna found in southern Wisconsin the "northern bur oak opening." This savanna type occurs from central Illinois in a thin strip into Minnesota. The type has a limited range, and Wisconsin is its center and offers the best opportunity for restoration, especially at larger scales. The Southern Unit of the Kettle Moraine State Forest, portions of the Central Sand Hills and Central Sand Plains, and some places in the Western Coulees and Ridges Ecological Landscape, are areas where significant management opportunities exist for this globally rare community. Some of today's scrub oak barrens or brush prairie communities, were historically pine barrens that lost their coniferous component and have been partially restored through mechanical and chemical reduction of woody cover and frequent prescribed burning. "Scrub" oak savannas with short, brushy structure, composed primarily of black and northern pin oaks, could be restored in the Central Sand Plains, Northwest Sands and Northeast Sands Ecological Landscapes.

Niagara Escarpment

The Niagara Escarpment is a bedrock feature composed mostly of Silurian dolomite. Strictly speaking, it's the steep, exposed side of a gently sloping bedrock ridge or "cuesta" that stretches from Lake Champlain in the northeastern United States westward across the Great Lakes to Wisconsin. Here the escarpment is exposed from the islands off of the northern tip of the Door Peninsula southwest for over 150 miles into southeastern Wisconsin where it disappears beneath glacial deposits. The escarpment supports many rare species, most notably a group of globally rare snails the oldest trees known in Wisconsin, karst topography, and important hibernacula for bats. It has value for migratory birds and bats by providing updrafts and generally north-south 'leading line.' Rare or otherwise important natural communities and habitats associated with the escarpment include dripping cliffs, dry cliffs, talus slopes, unusual conifer forests that contain the state's oldest trees, and, at one site on the Door Peninsula, the globally-rare alvar community.

Continentally Important Resources in Wisconsin

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Driftless Area Features

While the Driftless Area occurs in southeast Minnesota, northeast Iowa and northwest Illinois, 75% is found in Wisconsin. Unlike most of Wisconsin and the Upper Midwest, the topography here formed over millions of years without glaciation and is characterized by deep erosional valleys, exposed bedrock-controlled ridges and steep forested side slopes that support high species and community diversity and landscape heterogeneity. The rugged topography led to greater abundance and persistence of remnant community types destroyed or more greatly diminished elsewhere. Forest cover is relatively extensive compared to other parts of southern Wisconsin. Natural community types and habitats especially well-represented here are oak forests, mesic maple-basswood forests, floodplain forests, hemlock and pine "relicts," algific talus slopes, dry, or "goat") prairie, caves and abandoned mines with bat and herptile hibernacula, cliffs and associated rare plants and snails, and spring-fed cold-water streams. The lower reaches of several of Wisconsin's largest rivers occur here including the Wisconsin, Black and Chippewa rivers which all flow into the Mississippi River. These river systems are associated with broad floodplains containing extensive floodplain forests, marshes, and oxbow lakes. Where these are associated with large blocks of upland forest, the diversity of forest dependent wildlife is especially high and many rare species are present. The largest stand of southern bottomland hardwoods in the upper Midwest is located along the Lower Chippewa River.

Large Blocks of Old Deciduous-coniferous Forest (climate change resistant forest systems)

Large contiguous blocks of this forest type are embedded in a relatively unbroken forested matrix. These deciduous-coniferous forests have some of the most diverse assemblages of breeding birds on the continent. This strip of habitat stretches from Algonquin Park in Ontario to central Minnesota but does not extend very far north or south. Wisconsin is in the heart of this high diversity bird area. These forests are centers of abundance for many species, and are believed to be a source area for broadly distributed species. Distribution maps of many warbler species follow the same boundary and are associated with this forest. Locations in Wisconsin where these forests are extensive and offer good opportunities for large-block management are the Winegar Moraine and Penokee Range.

The Baraboo Hills occur on an outcrop of a unique quartzite

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formation and represent a part of the largest remaining block of dry-mesic and mesic forest in southern Wisconsin. The area has a high diversity of species and is considered one of the state's most important breeding sites for area-sensitive birds, especially those associated strongly with "southern" hardwood forests and Driftless Area conifer "relicts." The best of the conifer stands are embedded within a matrix of extensive hardwood forest, and are often associated with deep gorges cut through the bedrock by intact and ecologically important headwaters streams. The Baraboo Hills support a wealth of rare species and natural communities and have been a major focus of conservation efforts for many decades. The unique geological features have attracted worldwide attention.

Boreal Transition Forest

This forest type is seen only in parts of the coastal strip of Michigan and Wisconsin along the Lake Superior clay plain. It is associated with the local climate and has very different properties from the boreal forests in Canada. Wisconsin historically had white pine and white cedar abundantly represented in this community type, but virtually no primary forest is left. It was heavily converted and much of the area is still managed for aspen. The Lake Superior Clay Plain forest differs from boreal transition forests in Door County. In Door County, the overstory is similar but the substrate consists of shallow soils over dolomite bedrock and the ground flora includes Great Lakes shoreline specialists and plants strongly associated with dolomite bedrock In the Lake Superior Clay Plain the substrate is mostly deep lacustrine clay soils. Clay soils also have a high calcium status but are relatively impermeable to moisture infiltration, resulting in more wetland-like conditions. The Lake Superior forest has some boreal species not found on Door Peninsula. This area is important to boreal birds in Wisconsin. Climate change modeling suggests that areas next to the Great Lakes may retain the current climate the longest and might be places to concentrate efforts for protecting examples of temperate community types. The "snowbelt" along the Great Lakes may be the best place to manage for hemlock and other species requiring cool climates and constant, relatively high moisture levels.

Kettle Moraine Features

This is a large glacial interlobate moraine starting east of Lake Winnebago and running southwest for almost 90 miles into southern Wisconsin. It features rugged topography and contains many glacial features such as kames, drumlins and eskers. The vegetation is a complex mosaic of savanna, prairie, sedge meadow, marsh, calcareous fen and southern forest communities. Presently it is a large forested block in the midst of agricultural lands. Michigan has some similar topography but the interlobate moraine in Wisconsin was less suitable for conversion to agriculture than other regions and many of the natural features that have persisted here have all but disappeared elsewhere. Interlobate moraines with this combination of natural features at this scale are very rare, and possibly restricted to just a few locations in the Upper Midwest.

Large River Corridors

Wisconsin has a large number of lakes, rivers, and streams. Large rivers such as the Upper Mississippi, Wisconsin, Chippewa, Black, St. Croix, Brule, Wolf and Namekagon, Rivers are significant. An abundance of smaller coldwater streams emanating from glacial moraines and sedimentary bedrock in the unglaciated Driftless Area also occur here. The lower Wolf River is considered one of the few remaining rivers with a high degree of natural meandering needed by some aquatic species. The Winnebago pool lakes have a very significant population of lake sturgeon. These waters contain significant populations of fish and rare invertebrates such as mussels and dragonflies and the larger waterbodies also serve as major migratory bird stopover areas.

Upper Midwest Regionally Important Resources in Wisconsin

Glacial Lake Wisconsin

This area in central Wisconsin is in and around the bed of extinct Glacial Lake Wisconsin and is a biodiversity hotspot. The feature occurs in the Tension Zone and supports a unique mixture of southern and northern species. Many Species of Greatest Conservation Need, especially habitat and area-sensitive species, thrive in the area. Wet-mesic white pine-red maple forests are found here and support many sensitive species. The forests have few if any extant occurrences elsewhere in the Upper Midwest. Large expanses of dry forest and barrens occur here and the potential for barrens restoration is high. This is one of the two best places in the state and continent to manage for Midwestern barrens vegetation and its associated species. The state's largest area of contiguous wetland occurred here: 'The Great Swamp of Central Wisconsin' and there are large expanses of wetlands remaining, though many have been altered hydrologically by ditches and dikes. Sandstone buttes, mesas, cliffs, pinnacles, and gorges occur here; some with rare species. These features do not occur in other parts of the Upper Midwest.

Large Blocks of Predominately Older Northern Forest

The Blue Hills have quartzite bedrock and are similar in some ways to the Baraboo Hills. The area supports large blocks of relatively unfragmented forests. The high-gradient, soft water streams drain intact, forested watersheds, have significant diversity values and look similar to mountain streams. The area contains unique geological features especially the Felsenmeers "sea of rocks," which consist of extensive slopes of open, shattered quartzite talus with unusual lichen communities and dramatic cold air drainages, which are responsible for the presence of several notably disjunct northern species.

The Menominee Reservation has vast relatively unbroken hemlock-hardwood forests, scattered lakes, and ecologically important streams within forested watersheds. Large white cedar swamps are common in the eastern portion, where

marl lakes supporting calcium-loving plants occur. Prominent exposures of granitic bedrock occur along the Wolf River. Most of the forest is older than average for the state and supports significant populations of forest interior species that have become scarce in forests elsewhere.

Other northeast Wisconsin forest areas have rock outcrops, rivers, and extensive forests, some with bedrock close to the surface including cliffs, talus slopes, and glade communities. It needs more study as to its regional importance.

Large Sedge Meadows, Fens and Prairies

Although most of the tallgrass prairie has been lost, Wisconsin retains some significant prairie remnants. Avoca Prairie is the largest contiguous prairie east of the Mississippi River. Scuppernong Prairie and Military Ridge have significant numbers of remnants and very good potential for restoration. Chiwaukee Prairie is the largest wet-mesic prairie in the state. These remnants have high prairie species diversity. Among the largest concentrations of bluff prairies in the Upper Midwest occur in Wisconsin's portion of the Driftless Area. Many of these are associated with significant stands of oak forest and restorable oak savanna. The bracken grasslands occurring at Spread Eagle are part of this category.

Wisconsin has a large number of wetlands covered under the heading sedge meadow, especially floodplain forests, marshes, and peatlands, and to a lesser degree, fens and prairie wetland types. Wetland loss in neighboring states has been greater than Wisconsin's on a percentage basis. Cedar swamps are common in some parts of the state and harbor many rare plants.

Caves and Abandoned Mines

Wisconsin has several caves and abandoned mines that have become hibernacula for large populations of bats. Neda Mine is considered to contain the largest number of hibernating bats in the Midwest. Even though many parts of the mine were inaccessible for censusing, the population was estimated to include at least 300,000 little brown bats (*Myotis lucifugus*), and hundreds of northern longeared bats (*Myotis septentrionalis*), eastern pipistrelles (*Pipistrellus subflavus*) and big brown bats (*Eptesicus fuscus*) (Altenbach, unpublished data, 1995). Other abandoned mines known to harbor large numbers of hibernating bats occur along the Mississippi River and in the Penokee Range of far northern Wisconsin. Driftless Area caves also support bat hibernacula.

Medium-sized Rivers and Streams

These waters contain significant populations of fish and rare invertebrates such as mussels and dragonflies, but have fewer species than the larger waterbodies. River systems such as the Wolf, Jump, Bark and Namekagon fall into this category. They also serve as major migratory bird stopover areas and often harbor significant streamside natural communities.

Resources with State-level Importance

Extensive Grassland Communities

Native communities including prairies, sand barrens and fens, and non-native grasslands such as pastures, hay fields, etc. make up the grassland communities. Wisconsin has some of the best opportunities in the Midwest to preserve and restore tallgrass prairie and provide habitat for Henslow's sparrow and other grassland birds.

Working Northern Forest Communities

The 37 counties north of the Tension Zone contain 70% of the state's forested area. The area was drastically disturbed during the Cutover Period (1870 – 1930) and by subsequent fires. Currently maple-basswood and aspen-birch are the two most common forest types. Wisconsin is now one of the nation's top two forestry production states, and forestry is the largest employer in 27 northern forest counties. These large expanses of forest provide habitat for some of our most beloved species such as ruffed grouse, scarlet tanager, black bear and white-tailed deer. These species thrive precisely because Wisconsin has abundant habitat for them. Most places need not be identified for changes in focus because they are accomplishing many conservation goals with existing direction, but other areas harbor large blocks of mature forest, forested wetland, conifer uplands, or beech-hardwood forest where tweaks in management direct could enhance the viability for several SGCN.

Floodplain Forest Communities

A mix of hardwoods and wetlands characterize floodplain forest. Smaller patches along mid- sized streams harbor some species not found in forests along the major riverways. Fragmentation by agriculture, water impoundment and development has reduced connectivity. Patch size is shrinking and invasive species are an increasingly serious problem. With these combined factors, a few smaller floodplain forest systems merit priority to focus on resolving the threats and enhancing the potential the species will survive into the future.

High-quality Wetland Communities

Many different kinds of wetland communities have water-saturated soils or other substrates as their common characteristic. Ecological functions and food web relationships are different in wetlands than uplands. In Wisconsin half of the original wetlands were lost between 1780 and 1980. Wetlands are used by 43% of all federal listed threatened and endangered species and 32% of the state threatened/endangered species. Large patches of intact ash swamps or even disturbed, ditched and diked wetlands, such as Crex Meadows and Horicon Marsh provide habitat for and often times the largest populations of SGCNs in the state.

Diverse Aquatic Communities

The amount and high quality of Wisconsin's water resources are rare on a global scale and range from small ephemeral ponds to the largest freshwater lake by surface area in the world and includes a plentiful supply of groundwater. Runoff pollution,

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urbanization and development, recreation, fish stocking and harvest, and exotic species invasions are significant threats. Large river systems harbor a vast majority of the aquatic diversity, but several reaches of mid-sized streams provide habitat for specialized species.

Bedrock Communities

These small areas of the landscape often harbor rarely found or unique species due to the specialized habitat and harsh growing conditions. Bedrock communities can take the form of relatively flat glade communities, buttes and mesas or steep-walled gorge communities.

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Appendix 5. State Natural Areas Inspection Form

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State of Wisconsin
Department of Natural Resources
dnr.wi.gov

State Natural Areas Inspection Report
Form 170[illegible]021 (R 6/17) Page 1 of 2

See Manual Code 1751.1 for instructions.

General Information

State Natural Area Property Name	SNA Number

Inspector Last Name	First Name	Inspection Date

E-Mail Address	Phone Number

Facilities and Lands

1. Signs:	Repair	Replace	# signs needed	Comments
Boundary	☐	☐		
Interpretive	☐	☐		
Identification	☐	☐		

2. Land survey needed? ☐ Yes ☐ No

3. Facilities:	Install	Repair/ Replace	Comments
Fence	☐	☐	
Gate(s)	☐	☐	
Parking	☐	☐	
Access roads	☐	☐	
Trails	☐	☐	
Boardwalk	☐	☐	
Other	☐	☐	

4. Rare species management needed? ☐ Yes ☐ No
5. Photopoints established? ☐ Yes ☐ No
6. Survey monument/reference markers? ☐ Yes ☐ No

Invasive Species

	Occurrence new	Occurrence cont'd	Location/Notes
Garlic Mustard	☐	☐	
Leafy Spurge	☐	☐	
Spotted Knapweed	☐	☐	
Purple Loosestrife	☐	☐	
Reed Canary Grass	☐	☐	
Phragmities	☐	☐	
Buckthorn	☐	☐	
Bush Honeysuckle	☐	☐	
Gypsy Moth	☐	☐	
Eurasian Milfoil	☐	☐	
_____	☐	☐	
_____	☐	☐	
_____	☐	☐	

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Appendix 5. State Natural Area Inspection Form (*continued*)

State of Wisconsin
Department of Natural Resources
dnr.wi.gov

State Natural Areas Inspection Report

Form 1700-021 (R 8/07) Page 2 of 2

Ecological Management Needs

1. Active management needed? ☐ Yes ☐ No

a. Forest:
- ☐ Structural
- ☐ Composition
- ☐ Regeneration
- ☐ Burn
- ☐ Other: _____

b. Savanna:
- ☐ Thinning
- ☐ Slash reduction
- ☐ Species augmentation
- ☐ Burn
- ☐ Other: _____

c. Prairie:
- ☐ Brush removal
- ☐ Tree removal
- ☐ Species augmentation
- ☐ Burn
- ☐ Other: _____

d. Wetland:
- ☐ Brush removal
- ☐ Tree removal
- ☐ Burn
- ☐ Other: _____

e. Other Community Type: _____

Notes:

2. Natural Disturbance Factors: ☐ Oak wilt ☐ Insect defoliation ☐ Deer browse ☐ Beaver dams ☐ Blow down ☐ Other: _____

Is the disturbance affecting rare species? ☐ Yes ☐ No

Notes:

Is the disturbance affecting rare native communities? ☐ Yes ☐ No

Notes:

3. Human Abuse Factors: ☐ Unauthorized vehicle use (ATV, ORV, snowmobile) ☐ Volunteer Trails ☐ Litter / dumping ☐ Plant theft ☐ Timber theft ☐ Erosion ☐ Vandalism ☐ Graffiti ☐ Poaching ☐ Adjacent land use ☐ Other: _____

Notes:

Warden contacted? ☐ Yes ☐ No

Appendix 6. Supporting Resources

State Natural Areas Website: https://dnr.wi.gov/topic/Lands/naturalareas/

Ecological Landscapes of Wisconsin: https://dnr.wi.gov/topic/landscapes/book.html

Wisconsin's Natural Communities: https://dnr.wi.gov/topic/EndangeredResources/Communities.asp

Wisconsin's Rare Species: https://dnr.wi.gov/topic/endangeredresources/biodiversity.html

Wisconsin Initiative on Climate Change Impacts, Plants and Natural Communities: https://www.wicci.wisc.edu/plants-and-natural-communities-working-group.php

Wisconsin Wildlife Action Plan: https://dnr.wi.gov/topic/WildlifeHabitat/ActionPlan.html

Resilient and Connected Landscapes: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/resilience/Pages/default.aspx

The Vegetation of Wisconsin: an Ordination of Plant Communities, Curtis, John T. 1959. UW Press, Madison WI.

Wisconsin's Natural Communities, Hoffman, Randy. 2002. UW Press, Madison WI.

Invasive Species of the Upper Midwest: An Illustrated Guide to Their Identification and Control. Elizabeth J. Czarapata. 2005. UW Press, Madison WI.

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Appendix 7. State Natural Area Partners and their Organizations

SNA Partner	Partner Organization
Barron County	County
Chippewa County	County
Clark County	County
Dane County	County
Door County	County
Douglas County	County
Dunn County	County
Eau Claire County	County
Fond du Lac County	County
Jackson County	County
Jefferson County	County
Langlade County	County
Manitowoc County	County
Marathon County	County
Marinette County	County
Marquette County	County
Milwaukee County	County
Oneida County	County
Price County	County
Racine County	County
Rock County	County
Rusk County	County
Washburn County	County
Waukesha County	County
Winnebago County	County
Wood County	County
Beloit College	Educational
Lakeshore Technical College	Educational
Lawrence University	Educational
Madison Metropolitan School District	Educational
Silver Lake College	Educational
University of Wisconsin Board of Regents	Educational
National Park Service	Federal Agency
US Department of Defense	Federal Agency
US Fish & Wildlife Service	Federal Agency
US Forest Service	Federal Agency
Door County Land Trust	Land Trust/Non-profit
Groundswell Conservancy	Land Trust/Non-profit
Madison Audubon Society	Land Trust/Non-profit
Marshall's Point Association	Land Trust/Non-profit
Mississippi Valley Conservancy	Land Trust/Non-profit
National Audubon Society	Land Trust/Non-profit
Northeast Wisconsin Land Trust	Land Trust/Non-profit
Northwoods Land Trust	Land Trust/Non-profit
Ozaukee Washington Land Trust	Land Trust/Non-profit
Pleasant Valley Conservancy	Land Trust/Non-profit
Riveredge Nature Center	Land Trust/Non-profit
Standing Cedars Community Land Conservancy	Land Trust/Non-profit
The Nature Conservancy	Land Trust/Non-profit
The Prairie Enthusiasts	Land Trust/Non-profit
The Ridges Sanctuary	Land Trust/Non-profit
Waukesha Land Conservancy	Land Trust/Non-profit
Wisconsin Society for Ornithology	Land Trust/Non-profit
Woodland Dunes Nature Center	Land Trust/Non-profit
City of Madison	Municipal
City of Superior	Municipal
Town of Bayview	Municipal
Town of Holland	Municipal
Town of Washington	Municipal
Ho-Chunk Nation	Native American Tribe
Private Individuals	Private
Silver Lake Sportsmen's Club	Private
WE Energies	Private
Board of Commissioners of Public Lands	State
Kickapoo Valley Reserve	State

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